

A Manual of Concrete Masonry Construction



Concrete for Permanence

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TO INSURE the most satisfactory results with any building material, the user must thoroughly understand the proper methods of its employment in the class of construction in which he is engaging. The information contained in this booklet represents approved practices and methods, successfully employed in concrete masonry construction by architects, builders, concrete products manufacturers and others of wide building experience.

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Concrete Masonry Construction

RELIABLE estimates show that no less than 175,000,000 concrete block and concrete building tile were used in the United States during the year 1921, while for 1922 the total reached the vicinity of 300 million. This tremendous increase impressively reflects the popularity of precast concrete units for residences, schools, garages, churches and a wide variety of industrial and public buildings. New uses are appearing continually, while the demand for concrete block and concrete building tile for the well established older uses continues to grow rapidly.

Widely distributed factories and building material dealers carrying concrete structural products in stock, insure ready availability of these materials in almost every local community. Most manufacturers make guaranteed products, the quality of which is governed by the standards of the American Concrete Institute, reproduced in full on pages 30 and 31 of this booklet.

Similar rapid expansion is found in the concrete brick industry. While concrete brick are extensively used in plain masonry, the development of variously colored surface textures have extended their use to the best types of architectural design. In this booklet concrete brick masonry will not be discussed as it follows closely standard practice in ordinary brick construction.

The employment of concrete block and concrete building tile simplifies the work of both designer and builder, and gives the owner the advantages of rigid, permanent and maintenance-free construction with a saving in both the cost and the time required to build. The wall dimensions of available units lend themselves conveniently to any desired design and makes calculations simple. Concrete block and building tile lay up rapidly, bed firmly in the mortar and provide surfaces to which mortar and stucco adhere with great tenacity.



MORGAN PARK, a model industrial suburb of Duluth, Minn., is one of the several communities built almost entirely of concrete building units. For the

walls of houses, churches, schools, clubs, and stores, concrete block was found readily adaptable and satisfactory in every way.



Types of Concrete Block and Tile

The principal types are usually referred to as:

1. Hollow block.
2. Two-piece block.
3. Building tile.

Hollow block have cells or air spaces running vertically through the unit. Typical block of this type are shown in Figure 4, numbers 1, 2 and 3. Two-piece block, (see Figure 4, numbers 4, 5, 6 and 7), provide a continuous air space in the wall. The inner and outer sections of the wall are bonded together in numbers 5 and 7 by means of lugs or projections on the block which overlap in alternate courses. In number 4 the walls are held together with metal ties that are imbedded in the block when they are made, while in number 6 the metal ties are placed in the mortar bed when block are laid. The block shown in Figure 4, are easily identified by reference to the table on page 6.

In both the hollow block and the two-piece block the amount of air space varies from 20 to 40 per cent of their volume, but in most common types it approximates 33 per cent. The tendency is to increase the amount of air space to about 40 per cent, producing a lighter, more economical unit. Where extraordinary strengths are required, such as in courses directly supporting concentrated loadings, solid block are used. These may be made by omitting the mold cores or by filling the air spaces with concrete after the block have been laid.

Block are made in various sizes as shown in Table I. The 8 by 8 by 16-inch block is perhaps the most common. It makes a wall 8 inches thick and courses 8 inches high. Block are also made regularly for building walls 10 and 12 inches thick and with variations in height from 6 to 12 inches and in length from 16 to 30 inches, the 8- and 9-inch heights and the 16- and 24-inch lengths predominating. Veneer and partition block are made 6 and 4 inches thick and in common heights and lengths.

Concrete building tile are usually smaller in size and lighter in structure than block, the standard size being 5 by 8 by 12 inches. They are suitable for constructing walls either 8 or

12 inches thick according to the way the unit is turned in the wall. The height of 5 inches is equivalent to two courses of brick. The air space in tile amounts to 50 per cent or more of its total volume. Typical types of concrete building tile are shown on page 8.

Block and Tile Sizes

Figure 4 and Table I provide information relating to available types of concrete block while similar information pertaining to building tile is given in Table II, page 8, and the accompanying drawings. The dimensions given are the actual measurements of the units and do not include thickness of mortar joints. A block ordinarily spoken of as an 8 by 8 by 16-inch size usually measures $7\frac{3}{4}$ -inch by 8-inch by $15\frac{3}{4}$ -inch, allowance being made for $\frac{1}{4}$ -inch vertical and horizontal mortar joints. Most block 16 inches in length (or shorter) are designed for $\frac{1}{4}$ -inch joints, although thicker joints may be used with no difficulty resulting, except that of the irregular dimensions. Other block sizes are laid out for $\frac{5}{16}$ -inch, $\frac{3}{8}$ -inch and other thicknesses of joint up to $\frac{3}{4}$ -inch and some block molds provide adjustments to permit varying the joints.

For economy of construction, it is well to make as general use as possible of "normal" or full size block of standard dimensions. Considerable saving can be effected by keeping wall lengths and door and window openings as nearly as possible in multiples of whole and half block. Corner block, joist block, sills, lintels and other special shapes are generally made in dimensions to accord with those of the normal block used in the wall.

Surface Finish

There is a popular preference for stucco surfaces for houses and other buildings of moderate size because of the variety of artistic color and texture treatments available. Concrete block and tile provide the ideal backing for portland cement stucco. The surfaces of these units are sufficiently rough to produce a strong mechanical key and their density may be regulated to give uniform, effective suction. The rigidity of concrete

masonry construction is in itself an assurance against movement of the wall and consequent cracking of the stucco. These qualities insure an intimate and permanent bond. Since concrete block and tile and the cement mortar in which they are laid are of the same general composition and have practically the same absorption, the stucco hardens to a uniform color throughout. Further particulars on the application of portland cement stucco and the various artistic finishes commonly used are given on pages 26 and 27.

Attractively faced block with a modest display of precast concrete art stone have become a very popular combination for larger structures. Some of the most pleasing surface finishes are made by using selected colored aggregates in the facing. For example, white marble with a sprinkling of black marble or green-black copper slag, gives a surface which, when properly treated, resembles the costly natural marble. Buff pigment and graded marble chips with a sprinkling of mica spar produces a surface similar to limestone but with a life and sparkle resembling granite. Wide ranges of texture and color are available—including the entire range of marble, granite, colored sands and gravels and mineral pigments. In all of these surfaces will be found the distinct and pleasing individuality of concrete, not possessed by any natural stone.

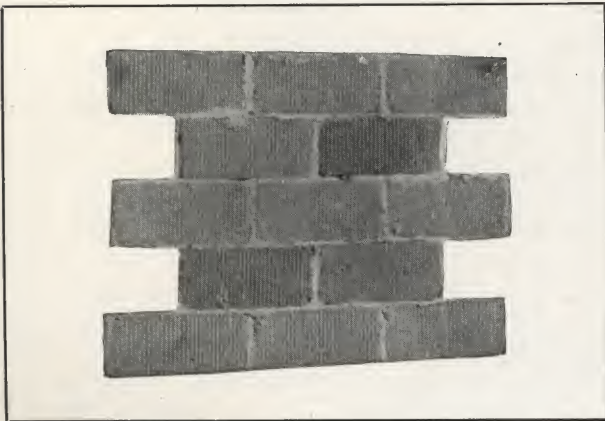


Fig. 1. Concrete building tile are extensively employed as a backing for stucco finishes.

Most concrete products plants carry in stock rough, flat-faced block for stucco covering and in addition one or two popular types of surfaced block suitable for the exterior faces of buildings to be finished without the stucco. Many plants

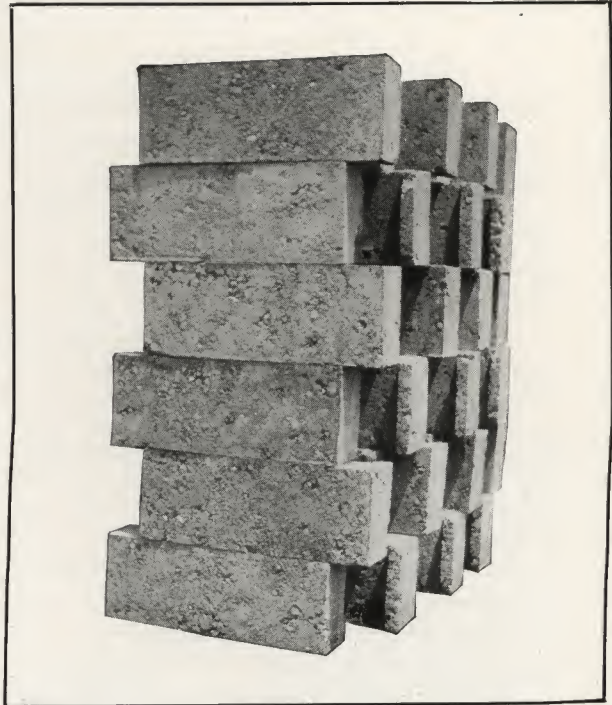


Fig. 2. Concrete block with rough texture surfaces provide a backing to which portland cement stucco clings tenaciously. The stucco cannot crack or separate from the wall.

are prepared to submit specimen faces in several textures and colors, and will make up block of special facing for individual jobs.

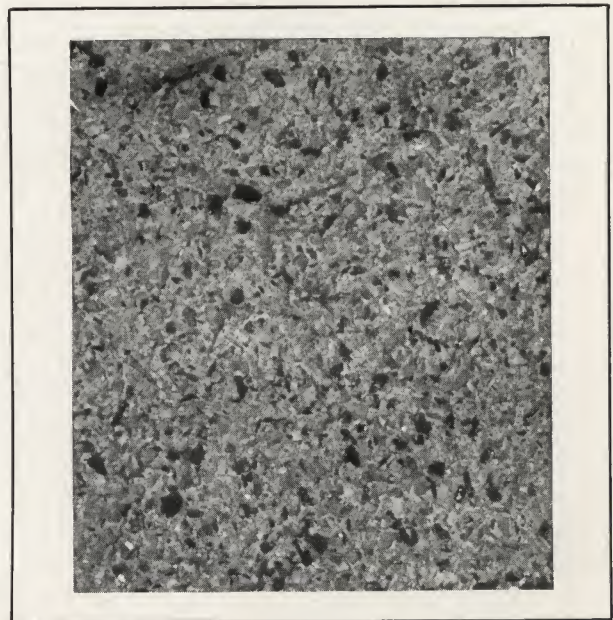


Fig. 3. Concrete block can be made to resemble granite, limestone or any other building stone by using the proper selection of aggregate and coloring in the facing. The manufactured product often surpasses the natural stone in attractiveness and permanence.

Table I
MANUFACTURERS OF CONCRETE BLOCK MACHINES AND
MOLDS AND EXACT SIZES OF BLOCK PRODUCED

(For approximate shape of various types of block see Figure 4)

Manufacturer and Trade Name of Equipment	Size of Concrete Block—Inches		
Type	Height	Width	Length
Acme Tile Co. Passaic, N.J. (Acme).....	12	8	16
Anchor Concrete Machinery Co. Columbus, Ohio.....			
(Anchor)	4	8, 9, 10, 11, 12	15 $\frac{1}{16}$, 23 $\frac{1}{16}$
(Hobbs)	1	2 $\frac{3}{4}$ to 11 $\frac{3}{4}$ by in.	15 $\frac{3}{4}$, 23 $\frac{3}{4}$ by in.
(Anchor Stripper).....	1	up to 9	15 $\frac{3}{4}$, 19 $\frac{3}{4}$, 23 $\frac{3}{4}$
Besser Manufacturing Co. 53 West Jackson Blvd. Chicago, Ill. (Besser).....	1	7 $\frac{3}{4}$	15 $\frac{3}{4}$, 19 $\frac{3}{4}$, 23 $\frac{3}{4}$
Bragstad Concrete Mach. Co. Canton, S. Dak. (Bragstad).....	4	7 $\frac{3}{4}$	10, 11, 12, 13, 14
Burrel Mfg. & Supply House Kankakee, Ill. (X-L-ALL).....	2	7 $\frac{3}{4}$	15, 16
Central Machine Co., Central Ave., Minneapolis, Minn. (Perfection)	3	5 $\frac{3}{4}$, 7 $\frac{3}{4}$	8, 10, 12
Geo. C. Christopher & Sons Wichita, Kans. (Eclipse).....	2	3 $\frac{3}{4}$, 5 $\frac{3}{4}$, 7 $\frac{3}{4}$	15 $\frac{5}{8}$, 23 $\frac{5}{8}$
Concrete Equipment Co. Holland, Mich. (Utility).....	2	7 $\frac{3}{4}$	4 to 12
Debay Research & Mfg. Co. Springdale, Pa. (Debay).....	2	7 $\frac{3}{4}$, 7 $\frac{5}{8}$	8, 10, 12
H. E. Erickson and Co. Minneapolis, Minn. (Papke).....	2	5 $\frac{3}{4}$, 7 $\frac{3}{4}$	15 $\frac{3}{4}$
Ferguson Synstone Co. Denver, Colo. (Synstone).....	5 and 8	11 $\frac{5}{8}$	4 to 16 by inches
Flexo Concrete Mold Co. Cedar Rapids, Iowa (Flexo).....	9	7 $\frac{3}{4}$	15 $\frac{5}{8}$, 23 $\frac{5}{8}$
J. B. Foote Foundry Co. Frederickstown, Ohio (Foote).....	2	7 $\frac{3}{4}$	8, 10, 12
Francis Concrete Mach. Co. St. Louis, Mo. (Francis).....	2	7 $\frac{3}{4}$	8, 9, 10, 12
Hayden Auto Block Mach. Co. Columbus, Ohio (Hayden).....	2	3 $\frac{3}{4}$, 7 $\frac{3}{4}$	4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24
Helm Brick Machine Co. Cadillac, Mich. (Helm).....	6	8	15 $\frac{3}{4}$, 17 $\frac{3}{4}$, 19 $\frac{3}{4}$, 23 $\frac{3}{4}$, 31 $\frac{3}{4}$
Hotchkiss Steel Products Co. Binghamton, N. Y. (Hotchkiss).....	2	7 $\frac{3}{4}$	4, 6, 8, 10, 12
Hydraulic-Ramming Conc. Stone Machine Co. Philadelphia, Pa. (Reconstructed Stone)...	7	8	8 to 24
Hydro Stone Co. 15 E. Van Buren Street Chicago, Ill. (Hydro-Stone).....	5	8 $\frac{5}{8}$, 11 $\frac{5}{8}$	16, 18, 24
Ideal Conc. Machine Co. Cincinnati, Ohio (Ideal).....	2	3 $\frac{3}{4}$, 5 $\frac{3}{4}$, 7 $\frac{3}{4}$	4 $\frac{1}{2}$ to 17
Kent Machine Co. Kent, Ohio (Post).....	1	7 $\frac{3}{4}$	23 $\frac{5}{8}$
Kramer Automatic Tamping Co. Peoria Heights, Ill. (Kramer).....	2	8	4, 6, 8, 10, 12
MacArthur Cement Products Co. Burlington, Iowa (MacArthur).....	9	7 $\frac{3}{4}$	8, 10, 12
Miles Manufacturing Co. Jackson, Mich. (Colonial).....	2	1 $\frac{3}{4}$, 3 $\frac{3}{4}$, 5 $\frac{3}{4}$, 7 $\frac{3}{4}$	8
Multiplex Conc. Machine Co. Elmore, Ohio (Multiplex).....	2	3 $\frac{7}{8}$, 5 $\frac{7}{8}$, 7 $\frac{7}{8}$	8, 10, 12
Peters-Eastman-Greer Co. Indianapolis, Ind. (P-I-C-A-B-B-S).....	10	3 to 6	7 $\frac{3}{4}$, 9 $\frac{3}{4}$, 15 $\frac{3}{4}$, 17 $\frac{3}{4}$, 21 $\frac{3}{4}$, 23 $\frac{3}{4}$
The Pettyjohn Co. Terre Haute, Ind. (Pettyjohn).....	2	8 or 7 $\frac{3}{4}$	8, 10, 12
Pyramid Tile Mach. Co. 434 Marquette Building Chicago, Ill. (Pyramid).....	11	8	7, 10
Raber and Lang Mfg. Co. Kendallville, Ind. (Improved).....	2	7 $\frac{3}{4}$	8

Table I—Continued

Manufacturer and Trade Name of Equipment	Size of Concrete Block—Inches			
	Type	Height	Width	Length
The Republic Iron Works Tecumseh, Mich. (Monarch).....	2	7 $\frac{3}{4}$	2, 4, 8, 10, 12	15 $\frac{3}{4}$
Sears, Roebuck and Co. Chicago, Ill. (Wizard).....	2	7 $\frac{3}{4}$	8, 9, 10, 12	15 $\frac{3}{4}$
S. P. Stone Co. 100 Arcadia Avenue Columbus, Ohio (Climax).....	9	7 $\frac{3}{4}$	8, 12	15 $\frac{3}{4}$, 23 $\frac{3}{4}$
U. S. Standard Mfg. Co. Columbiana, Ind. (Standard).....	1	7 $\frac{3}{4}$	3, 4, 5, 6, 8, 10, 12	15 $\frac{3}{4}$, 23 $\frac{3}{4}$
Universal Concrete Machine Co. Peoria, Ill. (Universal).....	1	7 $\frac{5}{8}$	4, 6, 8, 10, 12	15 $\frac{5}{8}$
The Wert Manufacturing Co. 80 East Jackson Blvd. Chicago, Ill. (Perfect).....	2	7 $\frac{3}{4}$	8	15 $\frac{3}{4}$
The Willsea Works Rochester, N. Y. (Hercules).....	2	3 $\frac{3}{4}$, 5 $\frac{3}{4}$, 7 $\frac{3}{4}$, 8 $\frac{3}{4}$	4, 6, 8, 10, 12, 16	15 $\frac{3}{4}$, 19 $\frac{3}{4}$, 23 $\frac{3}{4}$, 31 $\frac{3}{4}$
Zagelmeyer Cast Stone Block Mach. Co. Bay City, Mich. (Zagelmeyer).....	3	7 $\frac{11}{16}$	7 $\frac{11}{16}$, 11 $\frac{11}{16}$	15 $\frac{11}{16}$, 23 $\frac{11}{16}$

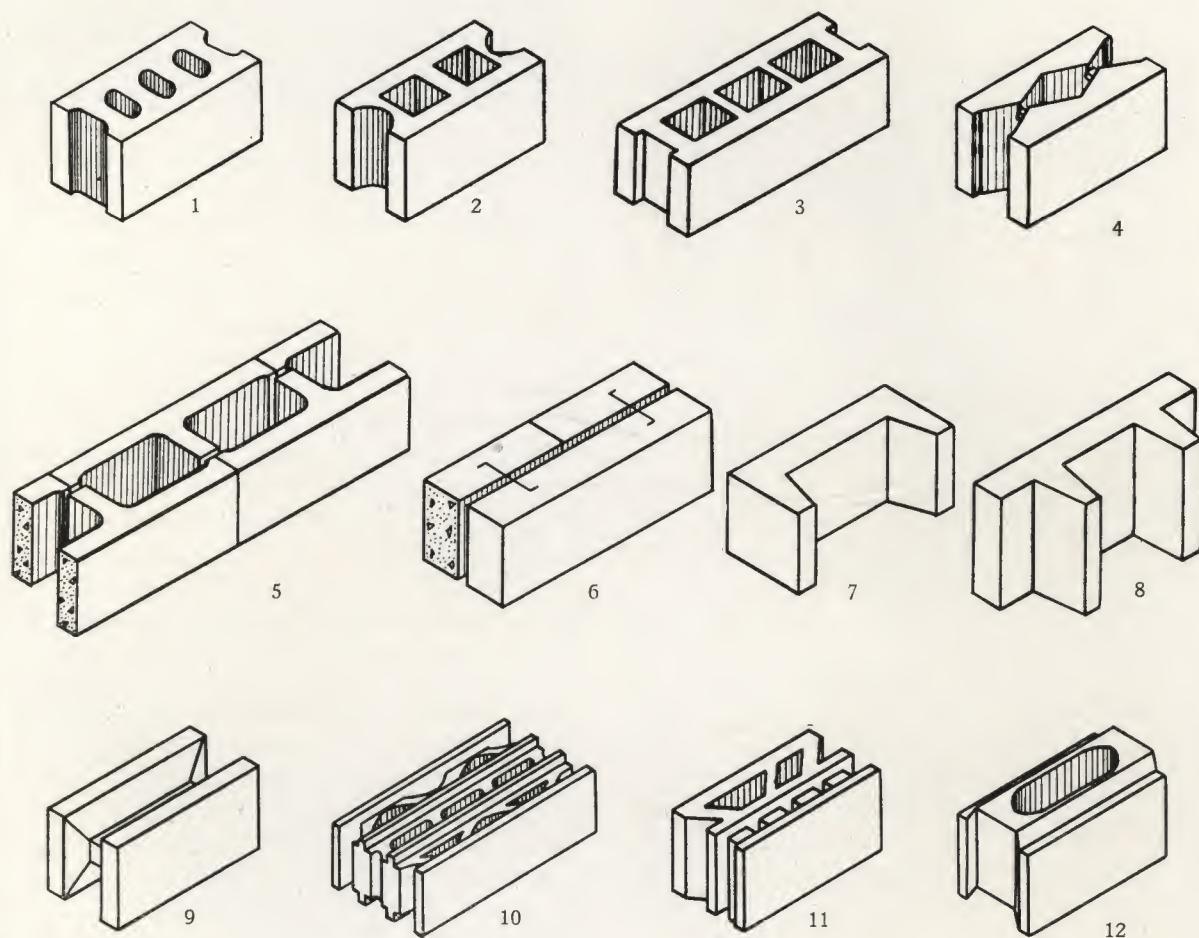
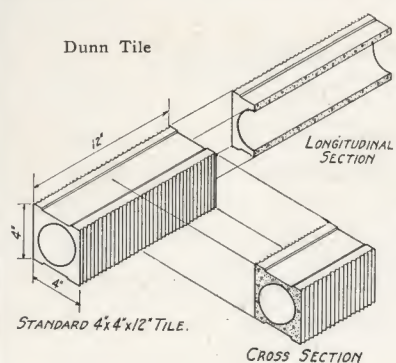


Fig. 4



Also made in sizes
6"x6"x12"
8"x8"x12"

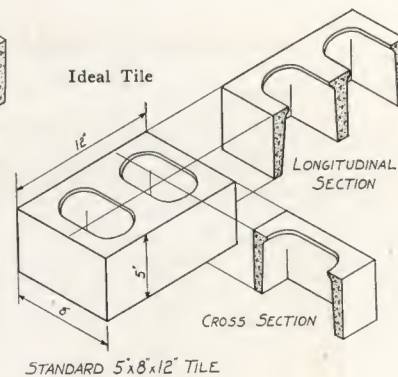
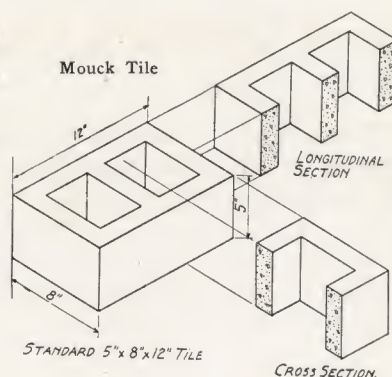
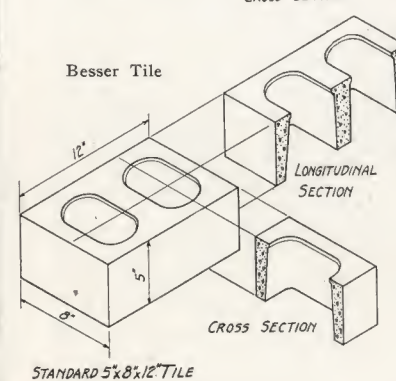
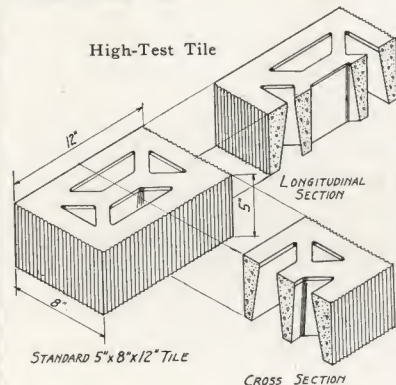
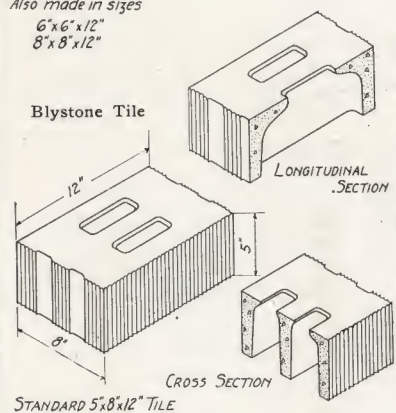
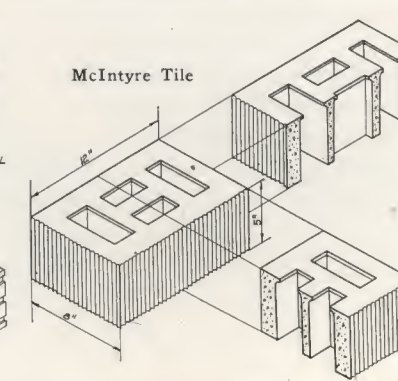
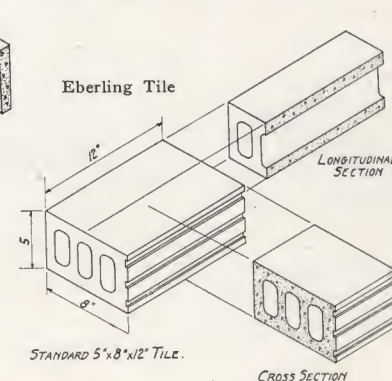


Table II
STANDARD CONCRETE TILE

Shapes and sizes and list of manufacturers of concrete tile machines.

Manufacturer and Trade Name of Equipment	Size of Tile—Inches		
	Height	Width	Length
American Concrete Industries Corp. Detroit, Mich. (McIntyre).....	5	4, 8	11¾
Anchor Concrete Machinery Co. Rock Rapids, Iowa Columbus, Ohio (High Test)...	5	4, 8	11¾
Besser Sales Co. 346 Monadnock Bldg. Chicago, Ill. (Besser).....	4, 5, 6	4, 6, 8, 10, 12	11¾
Blystone Manufacturing Co. Cambridge Springs, Pa. (Blystone)	5	4, 8	11¾
W. E. Dunn Manufacturing Co. Holland, Mich. (Duntile).....	4, 5, 6, 8	4, 5, 6, 8, 10	11¾
Eberling Machine Sales Co. Cleveland, Ohio (Eberling)....	3, 4, 5, 6	3⅞, 8⅞, 12½	10 to 14
Ideal Concrete Machinery Co. Cincinnati, Ohio (Ideal).....	4¾	16⅞, 3¾ to 17½ 4, 8, 12	11¾
Los Angeles Concrete Tile Co. Los Angeles, Calif. (Lac-Tile).	5	8	12



Characteristics of Concrete Masonry Walls

Wall Thickness

Thickness of walls is often regulated by state or local building codes. Eight inches is usually specified as the minimum thickness for exterior

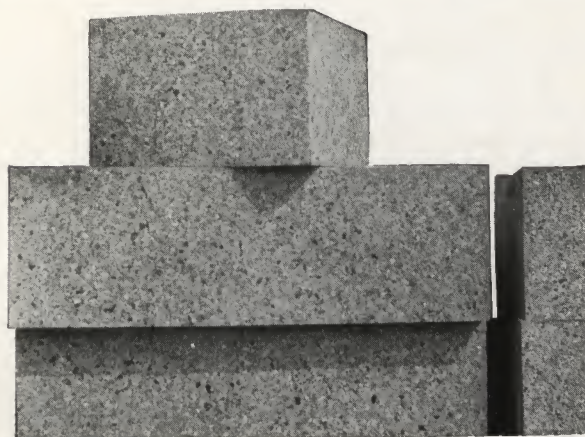


Fig. 5. Aggregates selected for their color produce an almost infinite variety of surface effects. The aggregates are exposed by scrubbing with water or acid solutions.

or load-bearing walls. Partition and curtain walls are often made only 4 or 6 inches thick and certainly need not exceed these dimensions if supporting only their own weight for short lengths with ordinary ceiling heights.

The thickness of bearing walls in heavily loaded buildings is properly governed by the limits of loading. The allowable working loads on concrete block, when laid in lime-cement mortar, is commonly placed at $1/10$ of the average crushing strength or, when laid in cement mortar, at $1/8$ of the average crushing strength. In dwellings, private garages and other small buildings, the actual loading of the units usually is much lower than this, frequently less than $1/25$ of the crushing strength, but as mentioned above, a minimum wall thickness of 8 inches has been commonly adhered to, regardless of load, largely for reasons of stability and convenience in construction. American Concrete Institute specification No. 10 for concrete block, which suggests the following arbitrary table of thicknesses for the walls of residences and apartment buildings (always only lightly loaded) represents acceptable practice, except that the 10-inch block indicated have been almost entirely replaced by 8-inch block.

Table III

Thickness of Walls (In Inches) of Residences and Apartment Buildings Where Dead Floor Load Does Not Exceed Sixty Pounds Per Square Foot

No. of Stories	Basement	First Story	Second Story	Third Story	Fourth Story
1	8	8	8	8	8
2	10	8	8	8	8
3	12	12	10	8	8
4	16	12	12	10	8

Bonding with Brick Construction

When concrete block and tile are used as a backing for brick veneer, the brick wall is usually bonded to the backing by means of suit-

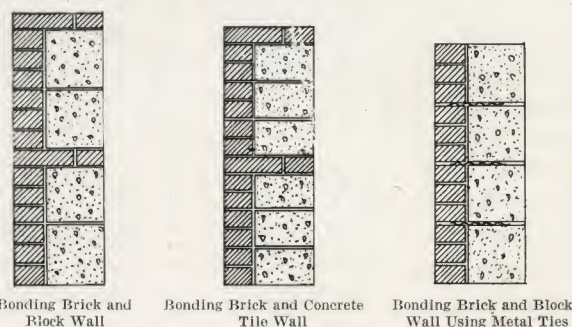


Fig. 6. Usual methods of bonding brick veneer to walls having a backing of concrete block or building tile.

able metal strips or ties as shown in Figure 6 or cross bond may be obtained by using header courses of brick. Where the block wall is joined to a wall of brick construction the units are laid as shown in Figure 7. Eight-inch concrete block equal in height three ordinary brick courses; five-inch concrete tile courses equal in height two ordinary brick courses.

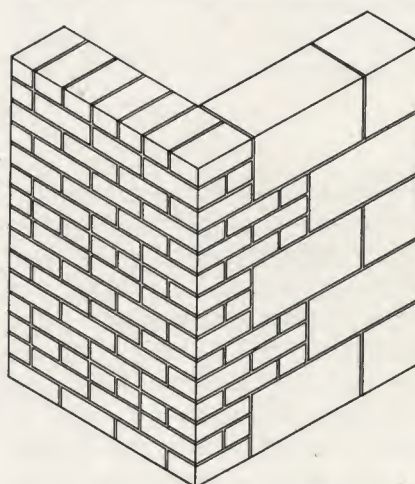


Fig. 7. Method of bonding concrete block and brick walls.

Mortar

Portland cement mortar is recommended for laying concrete building units because of its great bonding power, compressive strength, density and resistance to weather.

Portland cement mortar should be made with clean, graded sand and clean water. A small amount of well slaked or commercially hydrated lime is usually added to make mortar more plastic, or "fat," but the maximum quantity admissible is 25 per cent by volume of the cement

in the mixture (a proportion of approximately 10 per cent by weight, which amounts to about 10 pounds of lime to each sack of cement). Mortar mixed in the proportion of one sack (one cubic foot) of portland cement to 3 cubic feet of sand is generally considered most satisfactory. It should be mixed thoroughly with just enough water to give maximum plasticity. The batches should be only of such size that they can be used within 30 minutes after water is added. Retempered mortar should not be used.

Colored Mortars

Only finely ground pure mineral pigments are likely to produce thoroughly satisfactory colored mortars. Only pigments supplied by reliable manufacturers for use in cement mortar, are recommended. The amount of mineral color should not exceed 10 per cent by weight of the cement used, as larger quantities may affect the strength of the mortar. Successive batches of mortar must contain exactly the same proportions of cement, sand, coloring matter and water if exact color uniformity is to be maintained. A

table indicating the materials and quantities to be used in coloring portland cement mortar will be found on page 27. The mortar used in joining face block preferably should be a little lighter in color than the block. For most pleasing effects mortar colors should contrast only mildly with surrounding surfaces.

Types of Mortar Joints

Some of the most common types of mortar joints are shown in Figure 8. The flush joint and the two types of struck joints are made with the trowel. The *flush* joint is used when the wall is to be plastered or stuccoed. A *struck* joint is satisfactory if sloped to drain outward but is objectionable if the slope is reversed, forming a shelf on the block below where dirt and moisture may collect. Beading tools are used to form convex, and concave joints; the convex joint is ornamental but easily broken and, therefore, not recommended. The concave joint is pleasing in appearance and perhaps the most generally satisfactory type for exposed block walls. Raked joints are only occasionally used in exposed block work and while the effect produced by a workmanlike job is pleasing they afford lodgment for dirt, water and ice likely to increase staining or streaking.

Corner Returns

There are several accepted methods of making corner returns in block and tile construction, the choice being largely dependent on wall dimensions and the type of block or tile used. It is never necessary when making regular 90 degree corners to cut block or fill in with brick bats and in the interests of neat and workmanlike construction such makeshift means should be avoided.

Mortar joints should break at the midjoint as nearly as possible, even in masonry which is to be covered with stucco. Certain irregularities may be permitted in stucco construction for the sake of economy, since they will not appear in the finished work. In block work which is to be exposed (without covering of stucco) careful attention must be given to regularity of the joints. Accompanying illustrations show a number of corner arrangements for which special block are obtainable.

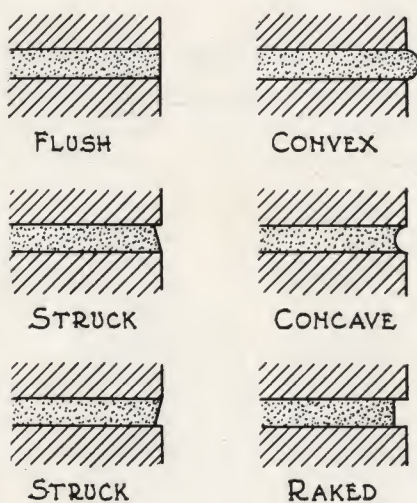


Fig. 8. Mortar joints used in laying concrete block and building tile. The flush joint is used when stucco is to be applied. The struck joint and concave joint are recommended in face block construction.

TYPICAL corner returns for concrete block wall construction. The use of special block in the corners saves mason's time and results in better workmanship. Most manufacturers regularly carry complete stocks of corner block to supply their customers' requirements.

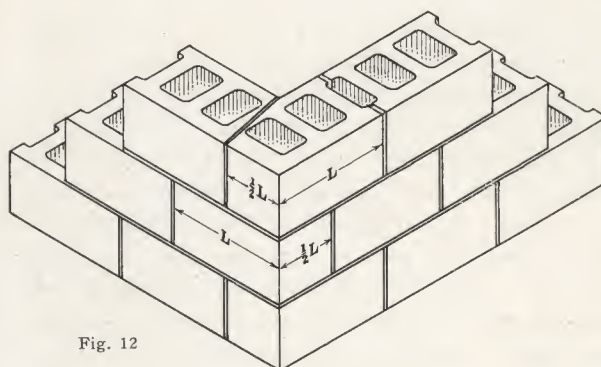


Fig. 12

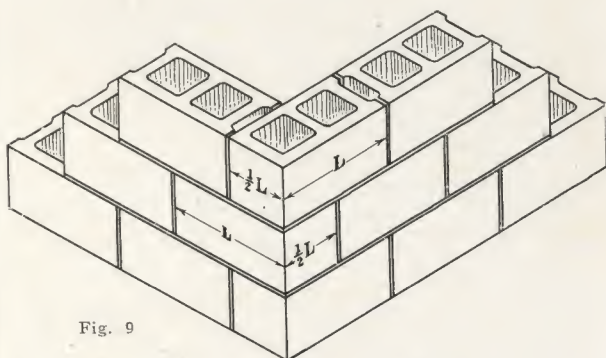


Fig. 9

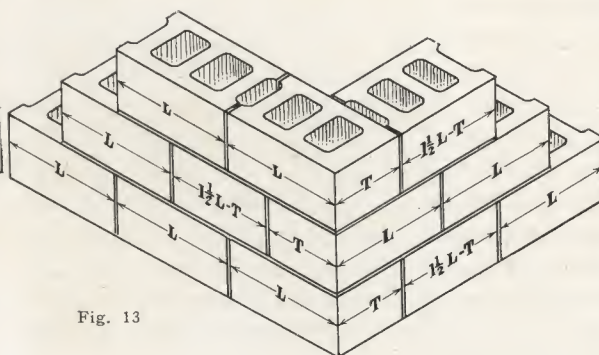


Fig. 13

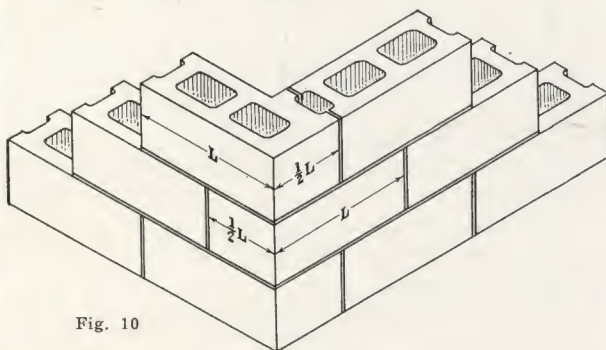


Fig. 10

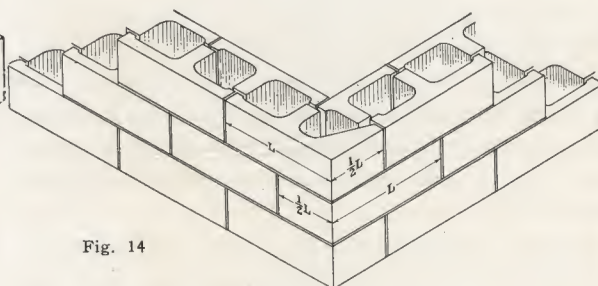


Fig. 14

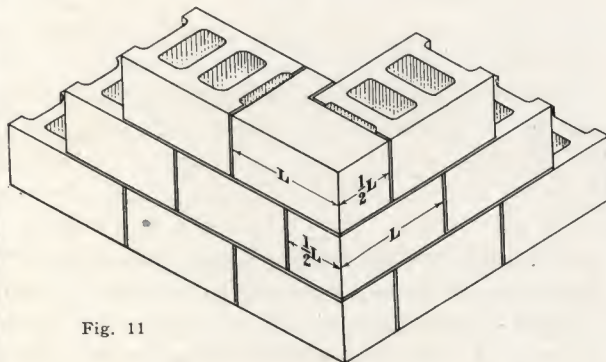


Fig. 11

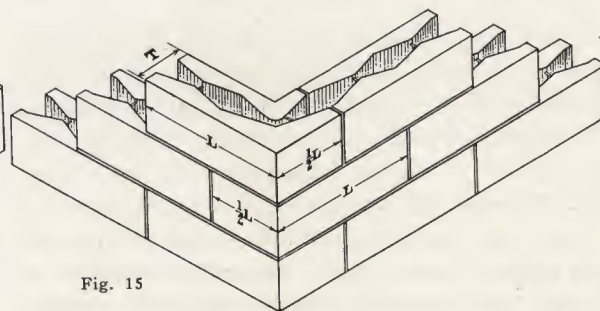


Fig. 15

When the construction is such that the wall thickness (block thickness) is equal to half the block length, the corner block are of the same dimensions as standard block (Figure 9). It frequently happens that the block thickness is greater or less than half the block length and in such case the corner may be constructed with special block as illustrated in Figures 10 and 11. These specials are made reversible by inverting them and are very desirable types because only one special unit is required in each course at the corner. This is a feature not possessed by the corner specials shown in Figure 12, which although of good substantial design, requires two specials in each course at the corner. Figure 13 illustrates a simple solution for the corner where the thickness of the wall is greater than half the block length. In this case the joints next to the corner do not break at the midpoints, but since the joint can be carried up consistently in a vertical line as long as block of the same thickness are used, the fact that it is slightly irregular is hardly noticeable. This corner is made by regular full length corner block in each course to the side of which is placed a special block having a length equal to $1\frac{1}{2}$ times a full block length, less the wall thickness.

If the thickness of the wall varies, the system of corner construction shown in Figures 10 or 11 is preferable to the one shown in Figure 13, particularly where the joints are exposed. In the latter construction, changes in wall thickness cause corresponding changes in the position of the vertical joint nearest the corners, which is undesirable.

Where two-piece block systems are employed, corners are usually constructed by means of specials reversed in alternate courses. Figure 14 shows a typical corner of a two-piece system where cross bond is secured by the overlapping projections of the block and Figure 15 shows the corresponding arrangement for a two-piece system using metal ties.

The Footings

Concrete footings and foundation walls must have sufficient strength to support the weight of the building safely and without settlement. When the foundation serves as a basement wall,

strength to withstand the lateral pressure of the soil is necessary, and it must also be watertight. In order to prevent possible upheaval by freezing, footings even for light structures such as porches or small garages must extend below possible frost penetration even though firm bearing soil is found at a shallower depth. The depth to which frost penetrates varies and may be as much as six feet in sections where winters are severe. Where in doubt as to frost depths, inquiry should be made as to common practice followed in the locality.

Concrete foundations should always be laid upon firm, dry soil. If soft soil, loam or decaying matter is encountered it must be removed. Obviously, the bearing power of soils is quite variable. Some earth is so soft that it cannot safely be loaded with more than one ton per square foot. Hard gravel and well compacted clay will carry about eight tons to the square foot while some rock can be loaded up to 100 tons. The width of the properly designed concrete footing should be such that the soil is loaded with a weight no greater than it can safely carry without possibility of settlement. A footing 18 inches wide and 12 inches thick is usually sufficient for a small residence and many competent designers and builders use an assumed size, such as this, in preference to figuring the weight of each house separately. However, the more painstaking method of procedure is to figure the weight in each case and establish the width of the footings accordingly.

The following table indicates the safe loads for various soils.

Character of Soil	Safe Load per Square Foot
Soft clay.....	1 ton
Wet sand.....	2 tons
Firm clay.....	2 tons
Fine and dry sand.....	3 tons
Hard, dry clay.....	4 tons
Coarse sand.....	4 tons
Gravel	6 tons

To calculate the proper width of footing, it is necessary to estimate the load to be carried (the weight of the building and contents) and to ascertain or make reasonable assumption of the bearing power of the soil.

Typical Calculation for Wall Footings

The following example shows the method of calculating the width of footing for the two-story concrete block residence shown on this page, Figure 16, located on soft clay soil that has a safe bearing capacity of one ton per square foot.

Combined "live" and "dead" loads are assumed to be as follows:

First Floor.....	50 lb. per sq. ft.
Second Floor.....	50 lb. per sq. ft.
Attic Floor.....	20 lb. per sq. ft.
Roof (including wind pressure).....	40 lb. per sq. ft.
Weight of 8-inch concrete block wall.....	70 lb. per sq. ft.
Weight of 10-inch concrete block wall.....	80 lb. per sq. ft.

No deductions are made for door and window openings.

Note that the "live" load is the load caused by contents and moving objects, and wind and snow loads, and that the "dead" load is the weight of

Since one square foot of soft clay soil will bear one ton (2,000 pounds) it will require approximately one and one-half square foot to carry 3,020 pounds. Therefore a footing 18 inches wide is needed. A footing of this width should be from 9 inches to 12 inches deep. A good rule to follow in the design of footings for small buildings is to make the depth of the footing a little more than one-half its width.

Calculation for Column Footing

First and second floor: 2 times 7 times 14 times 50 pounds.....	9,800 pounds
Attic floor: 7 times 14 times 20 pounds.....	1,960 pounds
Partitions	1,000 pounds
Total load on each column footing.....	12,760 pounds

Dividing 12,760 (pounds) by 2,000 (pounds) the load which one square foot will bear, gives

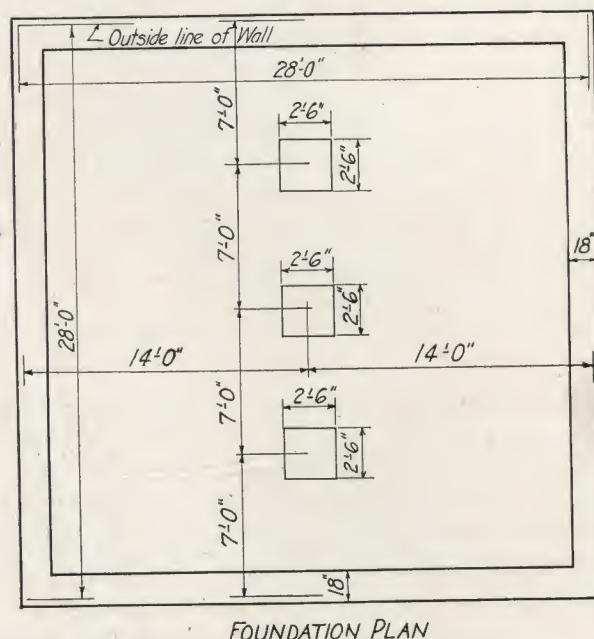
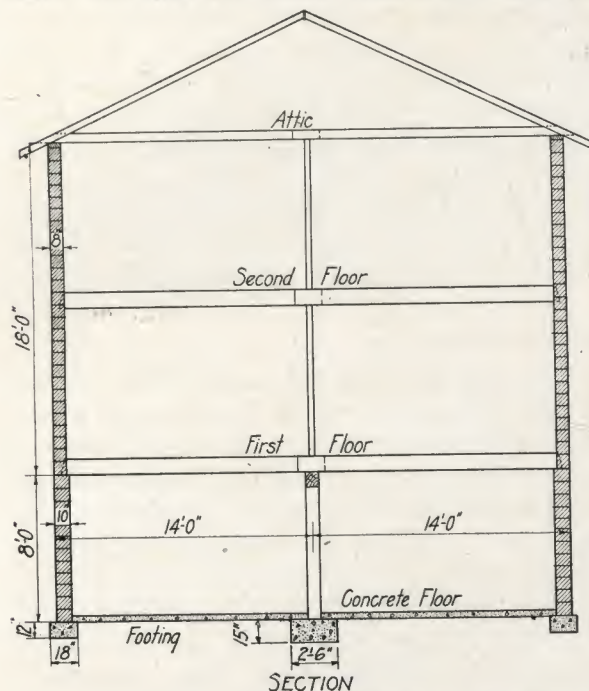


Fig. 16. Sketches for determining size of footings for houses built of concrete units.

the materials of the building itself. Each must be computed or estimated carefully in every case.

Load on Wall Footing per Lineal Foot

10-inch basement wall 8 feet high:	
8 times 80 pounds.....	640 pounds
8-inch superstructure walls 18 feet high:	
18 times 70 pounds.....	1,260 pounds
First and second floor loads, supported on walls,	
1/2 span: 2 times 7 times 50 pounds.....	700 pounds
Attic floor loads, 1/2 span: 7 times 20 pounds.....	140 pounds
Roof load: area times load divided by	
perimeter	280 pounds
Total load on wall footing per lineal foot.....	3,020 pounds

6.38 as the number of square feet needed to carry the load. A footing 2 feet 6 inches square will have the required area. This may seem a larger footing than is commonly used in small houses but it is needed to carry the load without danger of settlement. Central footings with too small bearing area frequently cause floor settlement.

In a similar manner the proper area of footings can be determined for any size of building or any weight.

Making Basement Walls Watertight

A dry basement is a positive essential of good construction. For ordinary, well drained soils the most important precaution in building the con-

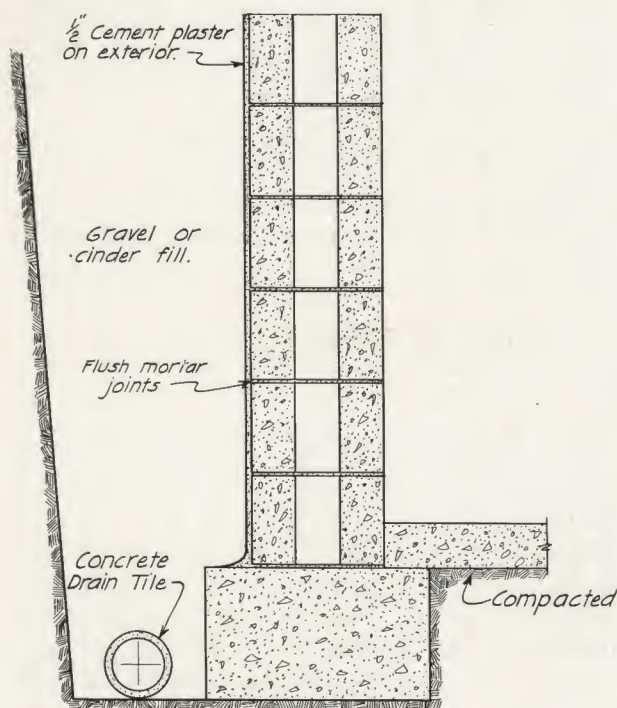


Fig. 17. Recommended method of building a dry basement wall.

crete block walls below grade is to see that joints are well filled with cement mortar and carefully pointed. If the subsoil does not have good drainage, a line of drain tile placed entirely around the outside of the footing and connected to a suitable outlet generally can be relied on to carry off excess water. Care should be exercised to excavate to proper grade so that there will be a uniform slope to the tile line with no low places. The excavation above the tile should be filled to a depth of one or two feet with gravel, cinders or some other materials of a porous nature through which water can seep easily. Backfilling may then be completed with earth, which is well compacted and the surface sloped away from the structure. If for any reason it is impossible to run a line of tile around the outside, the tile may be placed on the inside of the footing and slightly below it.

If the soil is very retentive of moisture or the water table is likely to rise much above the footing, special precautions are recommended. The usual treatment then is to apply to the exterior wall two or more coats of portland cement mortar mixed in the proportion of one sack of cement to two cubic feet of clean, well graded sand. All dirt and loose particles of mortar should be removed from the wall before the plaster is applied in order to obtain a strong, permanent bond.

Another common method of waterproofing is to coat the exterior surface with hot tar, pitch or other suitable asphaltic preparation, using a broom or fibre brush. The wall must be clean and absolutely dry when this coating is applied or it may not adhere perfectly. The plaster treatment is generally the more satisfactory. In extremely wet soils builders sometimes use both treatments, applying the asphaltic preparation on the plaster coating after it has hardened and the surface becomes dry. A recommended method of making ordinary basement walls watertight is shown in Figure 17. Deep basements and pits, located below the water level, present special problems requiring individual solution.

Basement Partitions

Basement partitions of concrete block or tile are recommended for carrying the weight of the floors and interior partitions as preferable to beams and columns, although for wide spans and heavy structures the latter are obviously necessary. The rigid support afforded by interior masonry walls insures that there will be practically no settlement of floors or interior partitions and consequently little if any cracking of plaster or loosening of interior trim. Such walls afford fireproof enclosures for heating equipment and fuel, confine steam, moisture and odors and provide insulation for fruit, vegetable or other perishables.

Concrete block and tile are much used for both load-bearing and non-load-bearing partition walls, also for fire-wall enclosures. Standard units are used for load-bearing walls while special units from 4 to 6 inches thick are often used for partition walls that do not carry loads other than their own weight.

Setting Door and Window Frames

Doors and window frames are usually built into the walls as the latter are laid. The frames should be well bedded and pointed in mortar. In high class work they are often caulked with oakum before pointing.

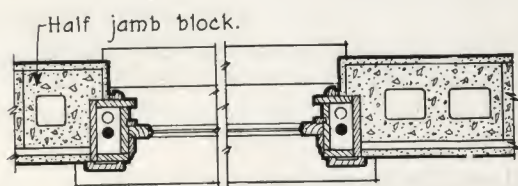
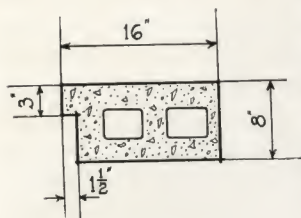


Fig. 18. Special door and window jamb block which save time in laying the wall and insure a more workmanlike job.

Door and window jamb block and tile are supplied to fit plank and box frames of all common designs and constitute one of the many convenient features of concrete masonry construction. By using these jamb block it is possible to make absolutely tight connections around the frames, excluding wind and water. Typical window jamb block for box frames are shown on this page.

Outside Fixtures

At the time concrete block or tile are laid, provision should be made for attaching downspout brackets, telephone and electric service wires and other house fixtures on the outside of the masonry walls. If the location of these fixtures cannot be determined as the walls are being built, it will be necessary to drill holes later. A

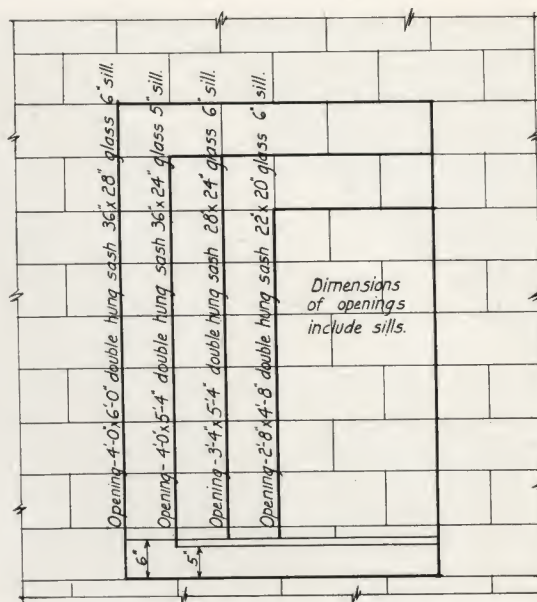


Fig. 19. Dimensions of openings for several sizes of windows using 8 by 8 by 16-inch block.

simple manner to provide for such connections is to place short lengths of small lead pipe in the mortar joints into which expansion bolts may later be inserted. These inserts should extend outward so as to be flush with the finished stucco, when used. If pipe inserts are flattened out and care is used, ordinary wood screws will hold. Several companies manufacture screw anchors for masonry walls.

Lintels and Sills

Precast lintels are generally more convenient and economical than lintels cast in place except possibly over wide spans where there may be a saving in clamping forms to the wall and casting

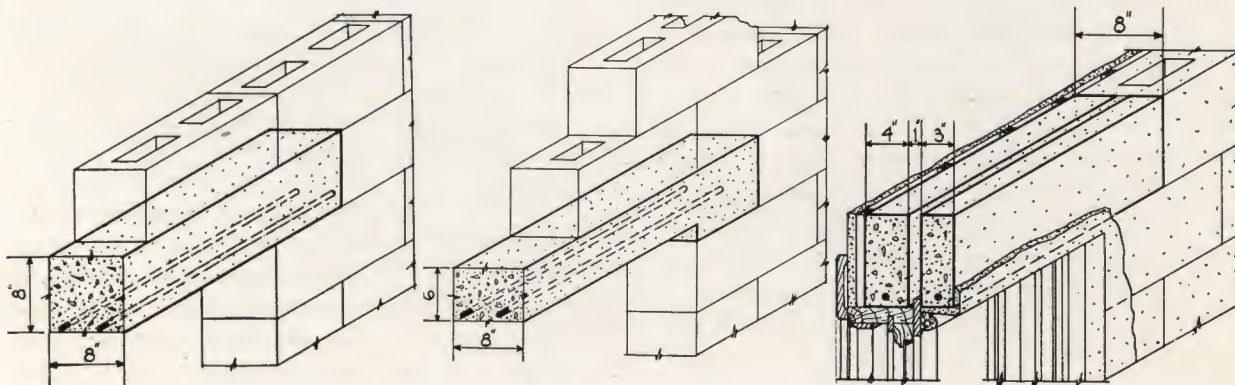


Fig. 20. Standard lintel details.

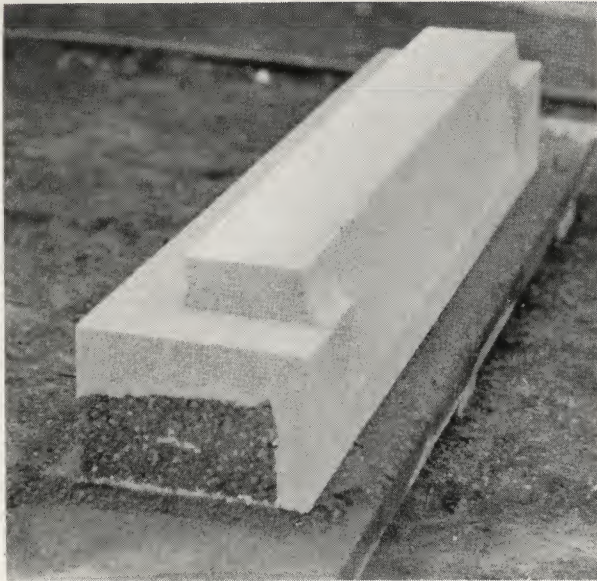


Fig. 21. A good sill design.

the lintel in place. Lintels are usually made the same height as the block courses. For example, if block 8 inches high and 8 inches wide are used, lintels are made 8 by 8 inches in cross-section and their length exactly equal to the wall length of one or more block. These lintels may be larger and stronger than required to carry the load in

most cases but the standardization of lintel sizes is a very great convenience in ordering and saves the time and the labor otherwise required to fit block around lintels of special dimensions. Reinforcement is always placed in lintels spanning openings of more than three feet, the steel bars being located about one inch above the bottom. Two half-inch bars are needed for a four-foot span and three for a five-foot span.

For use in connection with hollow block walls to be furred and lathed on the inside, one-piece lintels having the same thickness as the wall are obtainable. For walls with a continuous air space for insulation, where interior plaster is to be ap-



Fig. 23. Slip sills. Note groove along edge to form a drip to prevent water from running down the wall.

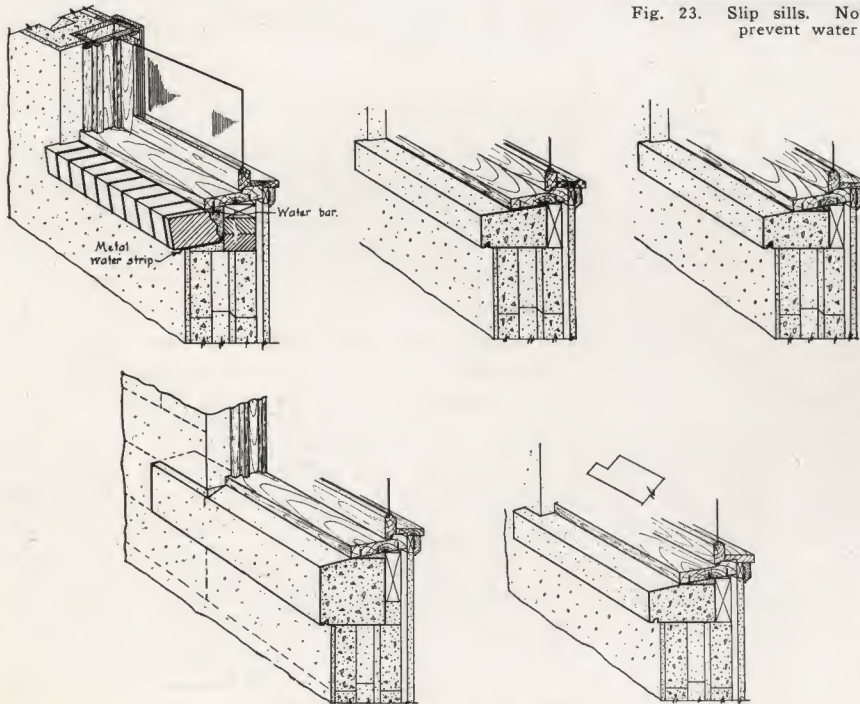


Fig. 22. Common types of sills.

plied directly to the masonry, lintels are "split" or made in two pieces to provide an air space between inner and outer sections. As a precaution, metal flashing may be placed over window heads in continuous air space walls, to guide condensed water away from the opening.

Precast lintels are regularly given all the surface finishes common to concrete block using the same process of manufacture. Lintels cast in the wall can be made to match block by using similar facing aggregate in a thin layer of concrete next to the outside face. After



Fig. 24. A precast sill to fit in with the block course. The dotted white lines indicate the ends of the sill made the same height as the block course.

forms are removed, the aggregate can be exposed by scrubbing with water or acid solutions or the surface can be tooled. No special surface treatment is necessary when the surface is to be stuccoed.

Window sills are usually precast like lintels. They should have a steep "wash" or slope to the weather. They should project at least two inches from the face of the wall and have a groove on the underside to form a "drip" to keep water from flowing over onto the face of the wall. They are often set at the time the wall is built; a better practice is to insert "slip sills" after the wall has been laid up. If built in, the joint below the sill should be left open and pointed up or filled after the wall has had a chance to settle as otherwise the slightest movement will crack the sill.

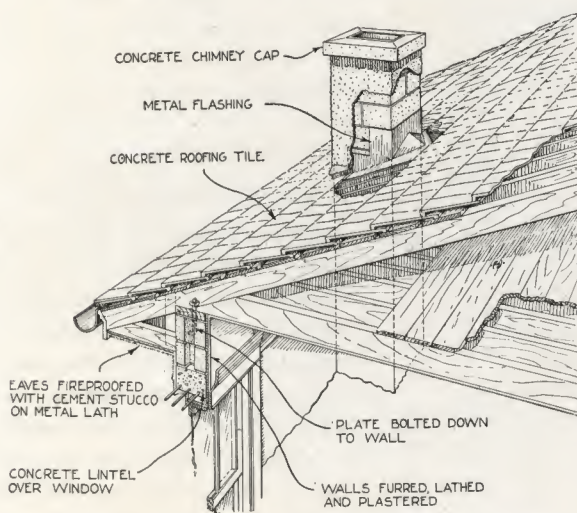


Fig. 25. Sketch showing upper portion of chimney.

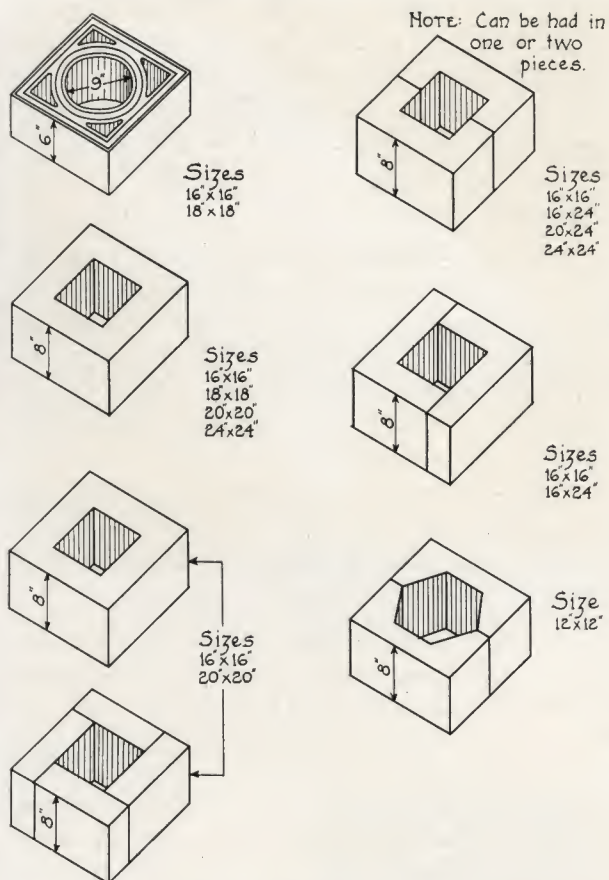


Fig. 26. Common types of concrete chimney blocks.

Chimney Construction

Several common types of concrete chimney block are shown in an accompanying illustration. Good chimneys, whether located on the interior or exterior of the buildings, always rest on solid concrete footings extending well below maximum frost penetration and of sufficient width and thickness to carry the weight of the chimney without danger of settlement. Chimneys should never be carried upon wooden floor beams or iron brackets or hung from rafters, joists or other wooden members. When the chimney forms a part of the wall of the house, the chimney block must be securely bonded into it. Chimneys will operate better if carried at least 2 feet above the ridge of sloping roofs and in cases of flat or nearly flat roofs, at least 3 feet above.

Cement mortar mixed in the proportion of one part cement to two parts sand is recommended

for chimney construction and the block should be damp when laid so as to develop a strong bond and tight joints. Flue lining, extending the entire height of the flue and breaking joints with the chimney block, affords added fire protection.

Fireplaces

Concrete fireplaces have the beauty, the dignity and the individuality which make them desirable in the better classes of homes. They may be constructed of concrete brick having any color tone or surface texture desired, or they may be built of concrete block or special concrete units, according to the architect's design.

Careful proportioning of the fireplace opening is necessary for successful operation. The following dimensions of openings are considered good practice:

RECOMMENDED DIMENSIONS FOR FIREPLACE OPENINGS

Width Inches	Height Inches	Depth Inches
32	28	17 to 21
36	28 to 30	21
48	32	21 to 25

Details of fireplace construction are given in the drawing on this page. The rear wall of the fireplace is arched or curved forward to form a wind shelf which deflects down drafts from the chimney and prevents dust and soot from being blown into the room. A damper placed in the throat for regulation of draft is essential.

Successful practice requires the inside area of flues to be not less than 1/10 of the area of the fireplace opening. Thus for a fireplace 30 inches wide and 27 inches high, the area of the opening is 810 square inches. The flue area should not be less than one-tenth of 810 or 81 square inches. An 8 by 12-inch flue will be satisfactory.

Each fireplace, stove and furnace should have its own individual flue carried full size to the top of the chimney. Immediately above the damper the sides of the opening are corbelled to the size of flue opening. It is essential that the flue rise directly over the center of the fireplace for at least two or three feet; it may then be corbelled over to the location desired. Sharp bends in the flue should be avoided.

The drawing of chimney details on page 19 illustrates how the opening over the damper is corbelled gradually to the size of the flue opening. It also shows how the fireplace flue may be corbelled over to make room for the furnace flue in case the chimney is centered directly over the fireplace.

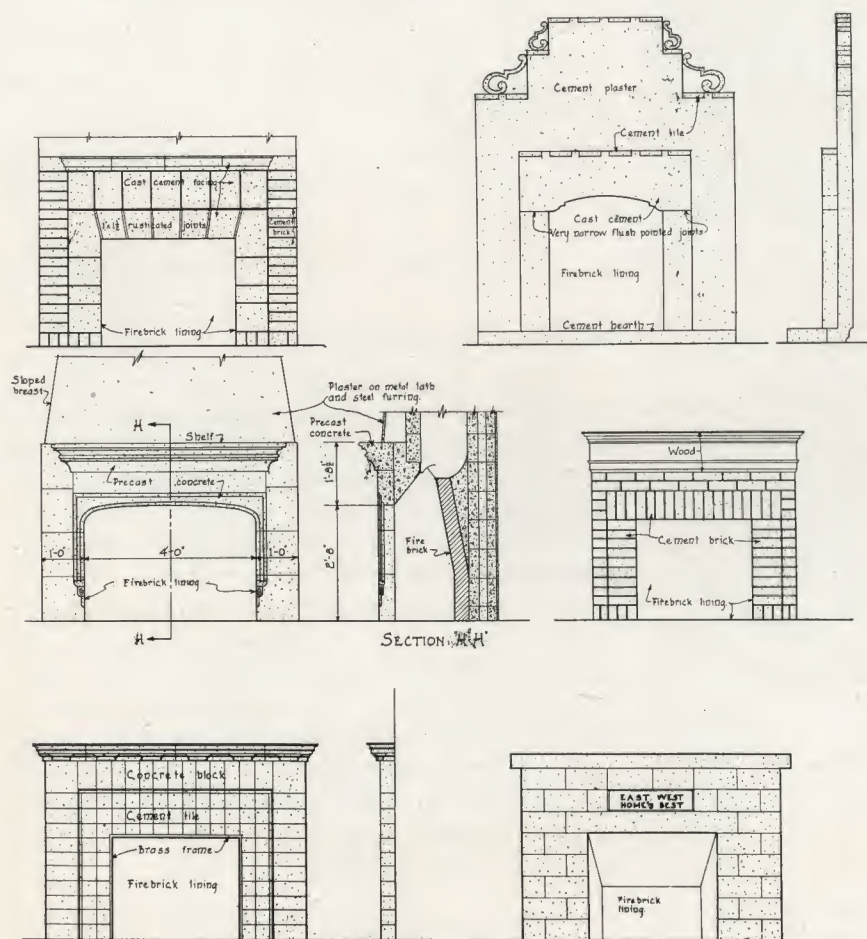


Fig. 27. Alternate designs for fireplaces.

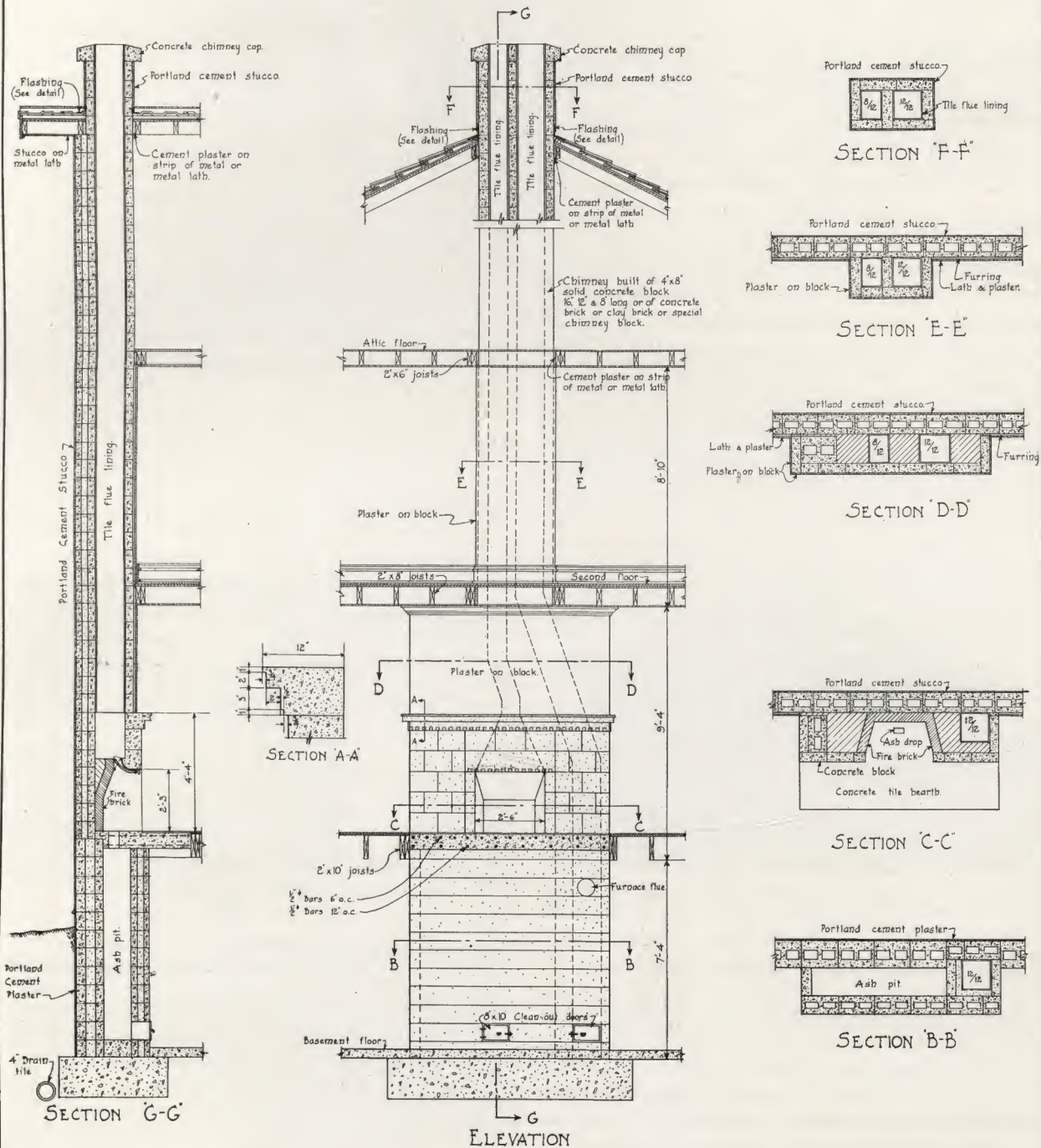


Fig. 28. Typical chimney construction details. A wide footing to sustain the weight of the chimney without settlement, chimney block carefully laid in cement mortar with joints well filled and flashing at roof to keep out moisture, are essentials of good chimney construction.

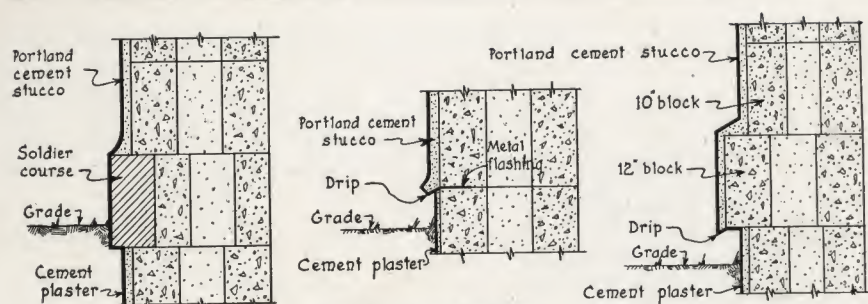


Fig. 29. Grade courses.

Belt Courses

Belt courses project from the face of the wall usually at grade line floor level, or higher up on the structure, for protection against the weather or for ornamentation. They may be constructed of special, precast units, of standard block set out (and covered with stucco), or of monolithic concrete. A course of block set out at the first floor level to form the water table provides bearing space behind it on which joists are conveniently set.



Fig. 30. Belt courses of precast units having exposed aggregate facing were used at the first floor line and at both sill lines of this concrete block house.

Methods of Supporting Wood Floors

An additional feature of great value and convenience is the joist block as shown in Figure 31, which provides rigid seating for wood floor joists. Where hollow block of a length equal to the joist spacing are used, the courses in which the joists are set usually take specials of the same shape as normals except for a notch cut out of each end or in some cases out of one end, to form space for the joist. As an optional method, veneer block are commonly used on the outside of the wall and corresponding block shortened to the

distance between joists used on the inside. This latter construction for the joist courses is quite flexible, and is equally adaptable for use with various types of block and any spacing of joists. When it is convenient to change the wall thickness at the joist

level, joists are set upon the shoulder or ledge formed by the thicker wall.

Underwriters demand a "fire cut" on the end of joists built into the wall so that in case of fire causing the collapse of a wood floor, the joists can fall out of the wall without endangering the stability of the latter.

Where wooden floors are used in the building, it is advisable to have a cement plaster on metal lath ceiling over rooms wherein are located heaters, boilers or stoves of any kind. Ceilings so protected have been found on test to resist a fire of more than average intensity for over an hour, thus adding materially to the fire protection afforded to the building, and giving the building a preferred insurance classification.

Support of Concrete Floors

A common method of supporting concrete floors on concrete block exterior walls is shown in Figure 33. Expanded

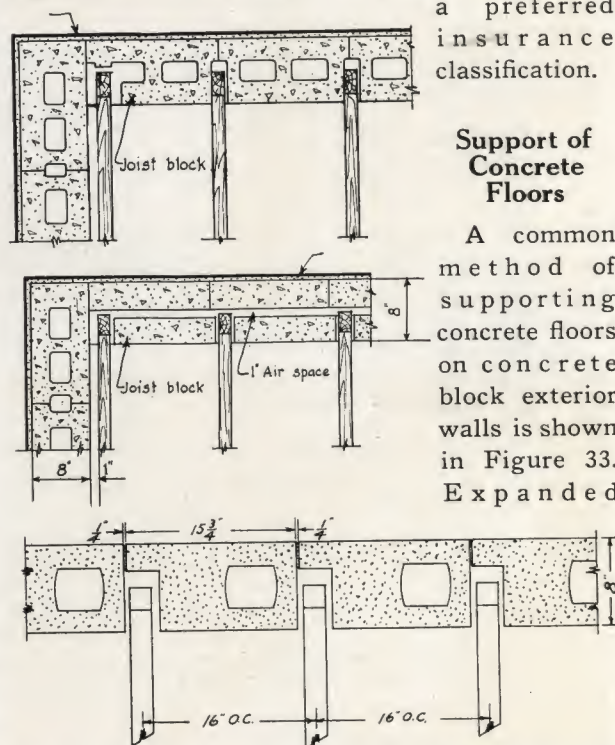


Fig. 31. Common types of joist block for hollow block and two-piece block wall construction.

metal fabric or wire mesh is laid over the exposed openings in the block to prevent the concrete from filling the air spaces below. The floor rests upon the inner half of the horizontal wall section, veneer block being placed on the outer edge leaving a small continuous air space between veneer block and floor slab. The floor should not extend over the entire width of the wall. If exposed on the exterior, the slab is likely to detract from the appearance of the wall and in case stucco is applied, cracks may be expected to appear should the slab expand or contract. Each individual floor presents special problems of design and construction, depending on loading, span and other factors and therefore should be designed by a competent structural engineer.

Several pleasing types of concrete floor finishes have been developed. Concrete floor tile of various sizes, colors and patterns are now produced by many concrete products plants and are available in almost every locality. The popu-

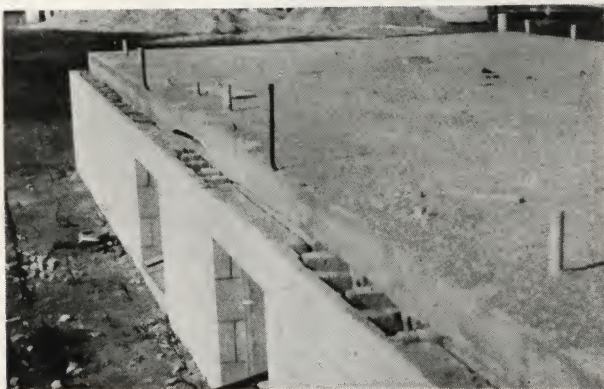
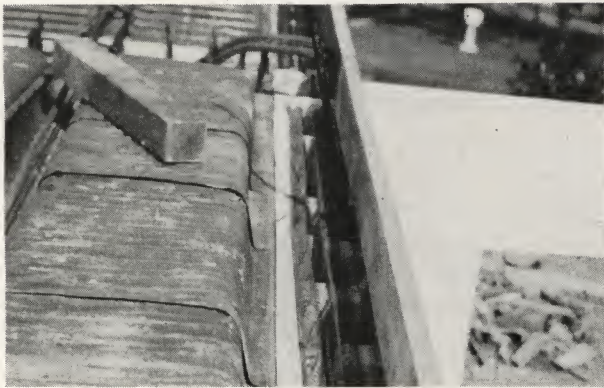


Fig. 32. Before and after placing a concrete floor with block walls supporting.

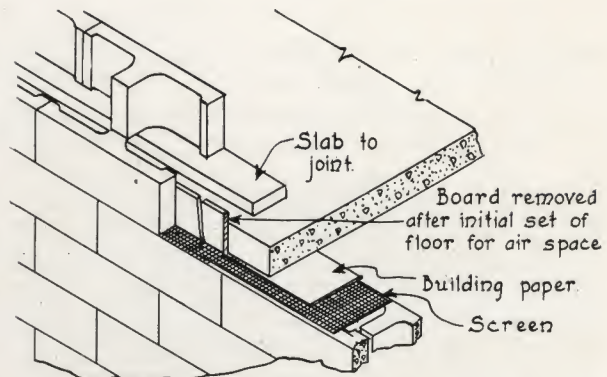


Fig. 33. Method of supporting concrete floor on two-piece type of wall. An air space is provided between floor slab and outer wall.

lar terrazzo finish is made by placing on the floor proper a surface layer of concrete about $1\frac{1}{2}$ inches thick made up of a decorative mixture of portland cement and marble chips and other colored aggregates. After this has hardened sufficiently, it is ground with a hand or motor driven carborundum grinder and polished to expose the aggregates, a very attractive texture resulting. A less expensive and equally appropriate treatment for stair halls, kitchen, bed rooms, bath rooms and closets, consists of rubbing the common concrete floor surface with a carborundum stone to remove little projections and coating the entire rubbed surface with a reliable concrete enamel.

Gable Construction

Concrete block and brick walls should not stop at the plate level but should be continued up in the gable ends of the building. Where walls are constructed of faced units, special triangular cut block are required at the ends of the gable courses, but when the surfaces are to be stuccoed the triangular openings may be filled with monolithic concrete. Verge boards are sometimes made wide enough to cover up these openings but this practice is not recommended. See illustration on page 22.

Attachment of Sills and Plates

The usual method of attaching wood sills and plates to concrete unit walls is to bolt them down at intervals, 6 feet apart or less, to the top courses. Bolts should be about 10 inches long with nuts and large washers inserted in the air cells of the block and filled around with concrete to insure firm anchorage. This method is much

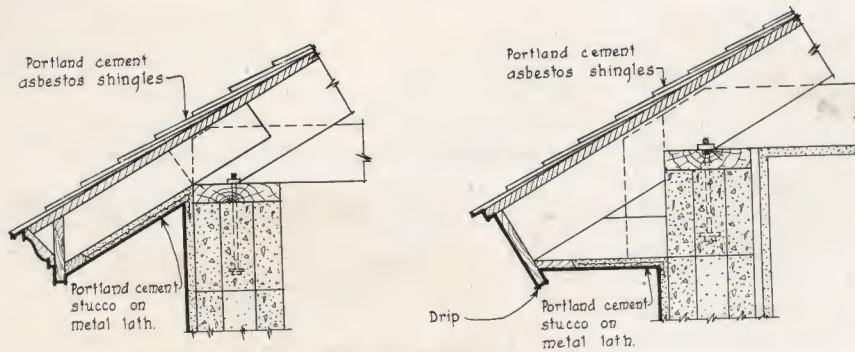


Fig. 34. Eave details.

more workmanlike and generally satisfactory than spiking sills or plates to wall through mortar joints.

Furring and Lathing

It is customary to "fur out" before applying plaster to the walls of buildings of all masonry

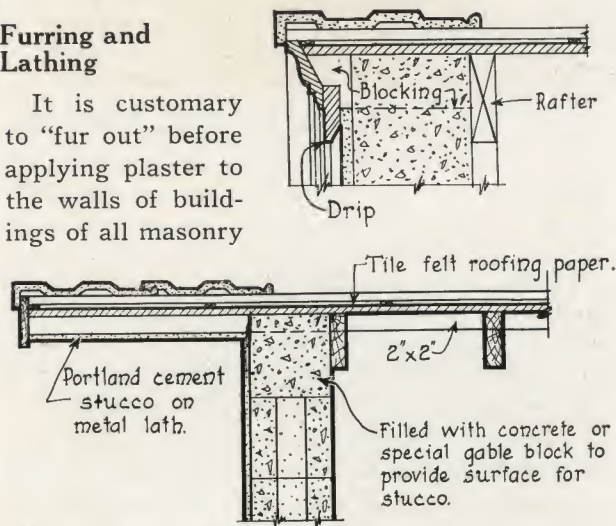


Fig. 35. Verge details.

materials, and this should ordinarily be done where concrete block are used. A continuous air space usually affords sufficient insulation so that plaster is about the same temperature as the inside air, preventing condensation. Special nails and screws have been devised for attaching furring strips. Sometimes small pieces of wood, often lath, are laid in the mortar joint flush with inside wall surface to afford facilities for nailing the strips. Furring need be attached only every three or four courses in height.

Prepared insulating materials, such as sheet cork, flax fibre, dried seaweed, etc., are sometimes used to line the interior wall making it unnecessary to fur out the plaster. Many of these can have plaster applied directly to them without the use of lath.

serve heat. For all other types of concrete block construction, plaster should be furred out where placed on the walls of residences and other buildings to be continually occupied. In localities where experience has proven that it is safe to plaster directly on brick, tile, or concrete walls, or for less important structures such as garages, industrial and farm structures where the atmosphere is generally dry and the possibility of a little condensation is of minor consequence, plaster, if used at all, is applied directly to the block.

Cleaning the Wall

After the wall is completed it should be scrubbed with a stiff fibre or wire brush and water, if it has been soiled or stained during construction. Serious stains may require scrubbing with a solution of muriatic acid varying in strength from about one part acid in three parts water to one part acid in eight parts water. The solution should be allowed to remain on the surface until it stops bubbling. It should then be removed by thoroughly washing with clean water.

Protection During Construction

Concrete art stone sills and ornamental

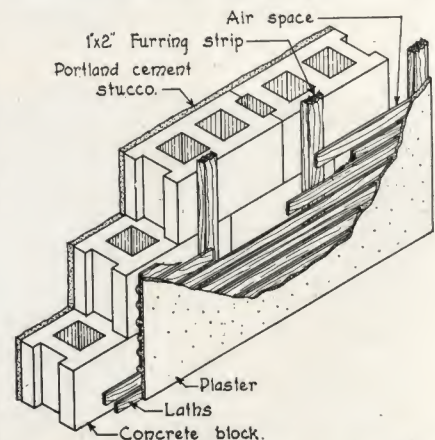


Fig. 36. All masonry walls for residences should have the plaster furred out to insure against condensation, two-piece and cinder concrete block possibly excepted.

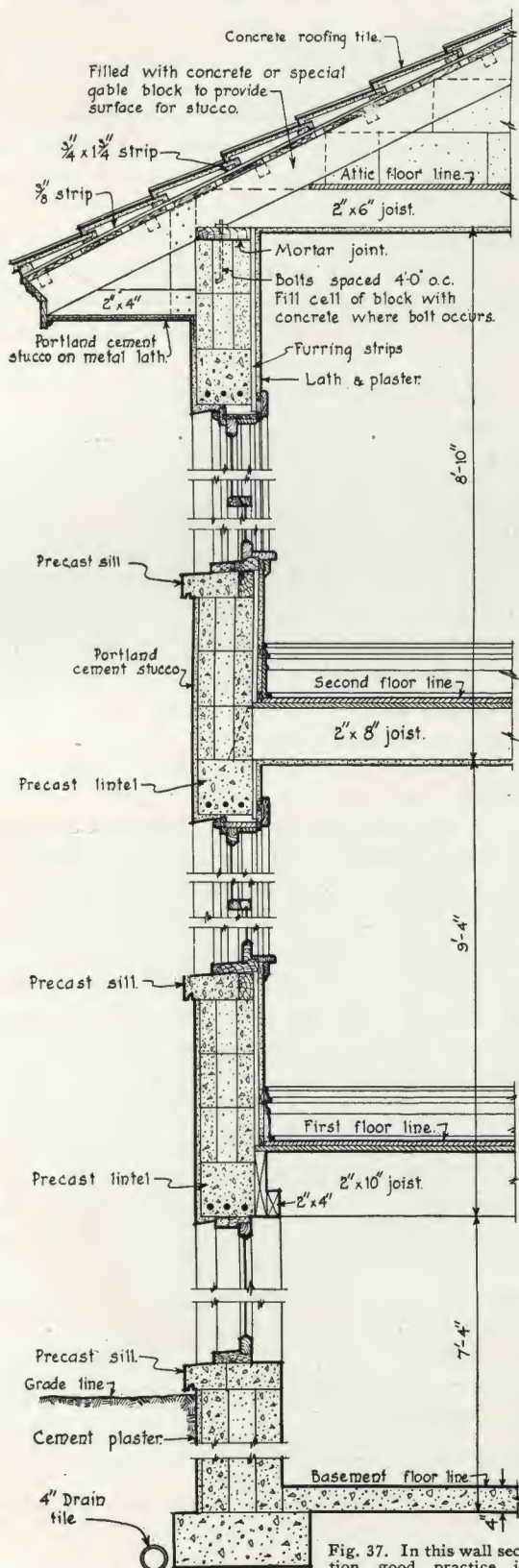


Fig. 37. In this wall section good practice is observed throughout.

work, as well as protruding and especially exposed portions of walls, should have suitable protection during construction. A covering of building paper does not afford sufficient protection under most circumstances. When projecting



Fig. 38. It is essential that trimstone and other exposed concrete have adequate protection during construction.

portions of the work are exposed to unusual danger of breakage or marring, they should be boxed-in as shown in Figure 38.

Concrete art stone sills and ornamental work should be handled with the same degree of care and given the same protection that is ordinarily given to cut stone. Although damaged concrete can be repaired, considerable skill and experience is required to match original work. Clean wall and unsoiled and undamaged building trim are indications of skill and superior workmanship which are of high advertising value to the builder.

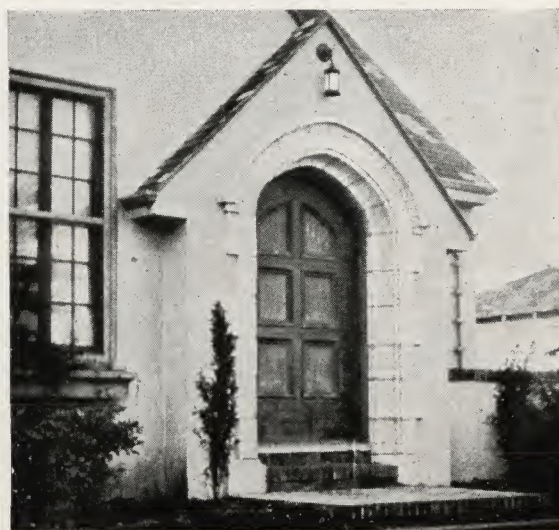


Fig. 39. A charming entrance-way illustrating the adaptability of concrete art stone.

Fire-resistive Roof Coverings

Underwriters' statistics show that inflammable roof coverings are responsible for over 20 per cent of dwelling house fires. This loss could be entirely eliminated by using concrete roofing tile or cement asbestos shingles. While not in competition with the cheaper roofings, both are moderate in cost and are available almost everywhere in a wide variety of colors.

Concrete roofing tile are generally produced in standard sizes of $9\frac{3}{16}$ inches by $14\frac{3}{4}$ inches (overall dimensions), 150 tile being required per square of 100 square feet. Their weight is approximately $5\frac{1}{2}$ pounds each. They are usually furnished with double side lock for effective exclusion of water and wind. Owing to the accurate plane surfaces and freedom from warpage which is a conspicuous feature of concrete roofing tile, 3-inch end lap is sufficient for good construction. They are commonly furnished in standard colors of red, green and gray, but usually can be obtained in special lots in any variety of colors desired.

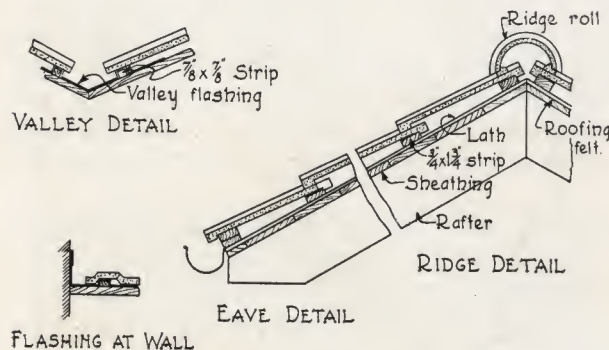


Fig. 40. Cross-sectional views of typical concrete tile roof.

Typical construction details of concrete tile roof are presented. The supporting rafters should not be less than 2 by 6 inches in size, spaced 20 inches apart, center to center, connected with collar or tie beams to prevent spreading and covered with 1-inch seasoned sheathing, close laid and firmly nailed. Advance preparation of flashing and sheet metal work permits faster progress and better work in laying the tile. With the aprons and counter-

flashing raised to admit the felt, the laying of the roof is done according to the following procedure:

Laying Concrete Tile Roofs

Cover sheathing with approved 12-pound, or heavier, roofing felt laid parallel to the eaves and

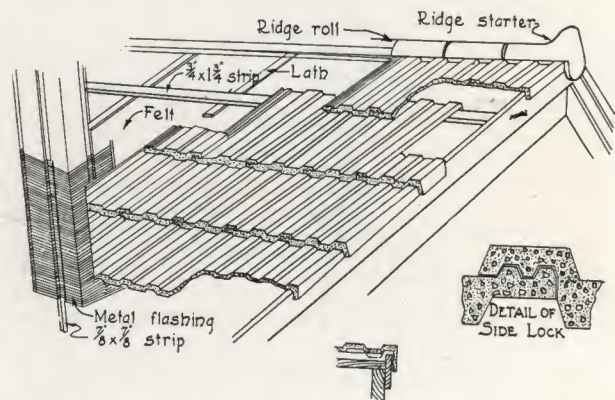


Fig. 41. Typical details of concrete tile roof.

lapped at least half its width in every course. Lay an extra ply of felt next to the eaves; cap the hips and ridges with an extra longitudinal strip at least 12 inches wide and extend the felt up against vertical walls at least 6 inches under counter-flashing. In valleys lay one extra ply longitudinally.

Lay continuous lath weeper strips on 18-inch centers from eave to ridge at right angles to ridge. Attach to the weeper strips and at the right angles to them, $\frac{3}{4}$ by $1\frac{3}{4}$ -inch battens (accurately spaced to accord with the length of the tile). Lay tile carefully so that when finished the courses will present a straight and uniform appearance when viewed vertically, horizontally or diagonally. Cover hips and ridges with accurately laid ridge roll, bedded in 1:3 cement mortar colored to match roofing tile.

Cement Asbestos Shingles

Cement asbestos shingles are approximately $\frac{3}{16}$ -inch thick. They average in weight about 435 pounds per square (100 square feet) for the American (rectangular) type and about 275 pounds per square for the French, or diagonal,

type. They are made in a variety of shapes and are commonly furnished in standard colors of gray, red, brown, dark slate and green.

The recommended method of laying cement asbestos shingles together with the different shapes required for each method are illustrated on this page, Figures 42, 43 and 44.

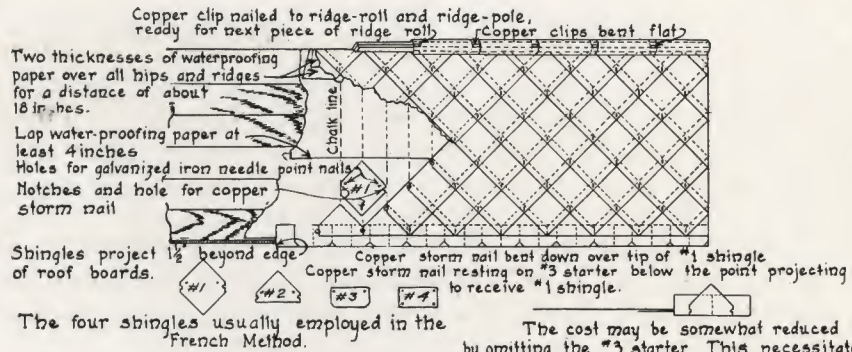


Fig. 42. French method.

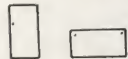
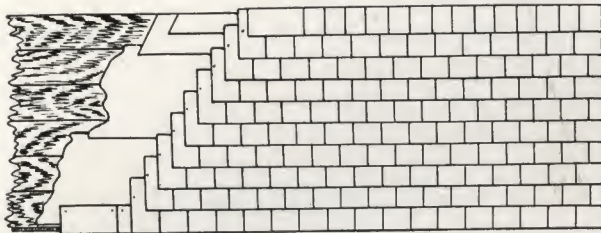


Fig. 43. American method.

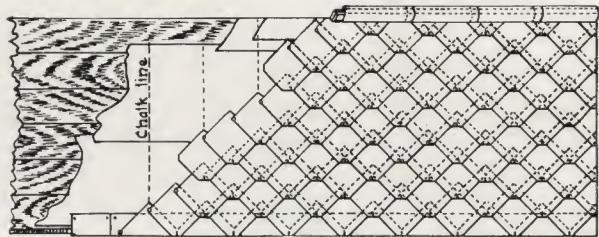


Fig. 44. Honeycomb method.



Cement Asbestos Shingle, rectangular method.



Concrete Roofing Tile.



Diagonal method.

These fire-resistive roofings are made in a variety of colors and tones to meet every artistic and architectural requirement.

Concrete Block as a Base for Stucco

Concrete block and concrete building tile provide an ideal backing for portland cement stucco. Block and tile to be used for this purpose are manufactured with a rough, coarse texture to provide a good key or mechanical bond for the stucco, and a certain suction which aids in applying the stucco and holds it permanently as an integral part of the wall. See Figure 45.



Fig. 45. A permanent stucco on a permanent backing. Portland cement stucco adheres readily to concrete block or tile. The freedom from irregularities means economy of stucco materials.

Where stucco is to be applied to concrete masonry, mortar joints should be cut flush with the surface. Immediately before applying the first coat of stucco, dust and loose particles

should be brushed off and the wall dampened. Two coats of portland cement stucco are sufficient when applied on concrete block or tile backing and these need only be sufficiently heavy to cover entirely the backing and bring the wall out to the desired plane.

Portland Cement Stucco Mixture

Portland cement stucco mixture in the proportion of about one sack (one cubic foot) of cement to about three cubic feet of sand or stone is considered most satisfactory for all coats. Leaner mixtures may prove porous while richer mixtures are avoided in order to prevent the fine hair lines known as surface crazing. Hydrated or

well slaked lime is sometimes added to give the mixture greater plasticity but the amount should never exceed 10 pounds for each sack of cement. Larger quantities of lime materially reduce the strength. Exactly the same proportions of cement, sand and water, coloring matter and any other ingredients must be used in successive batches for the same coat in order to give the finished surface a uniform appearance. Sand should be clean, well graded and pass through a screen with eight meshes to the linear inch.

In making cement mortar, cement and sand should first be mixed together dry, preferably with a machine mixer, until the mixture is of uniform color throughout. Then only enough water should be added to produce, after thorough mixing, a mortar that is plastic and workable. Batches so large that they cannot be applied in 30 minutes are undesirable for the mortar will probably become too stiff in which case the plasterer may want to add more water (retempering) which is not recommended. Mortar that has stiffened should not be used.

Application of Stucco to Block Surface

The first, or scratch, coat can be applied at any time after the wall is completed, carrying on the plastering in one general direction without

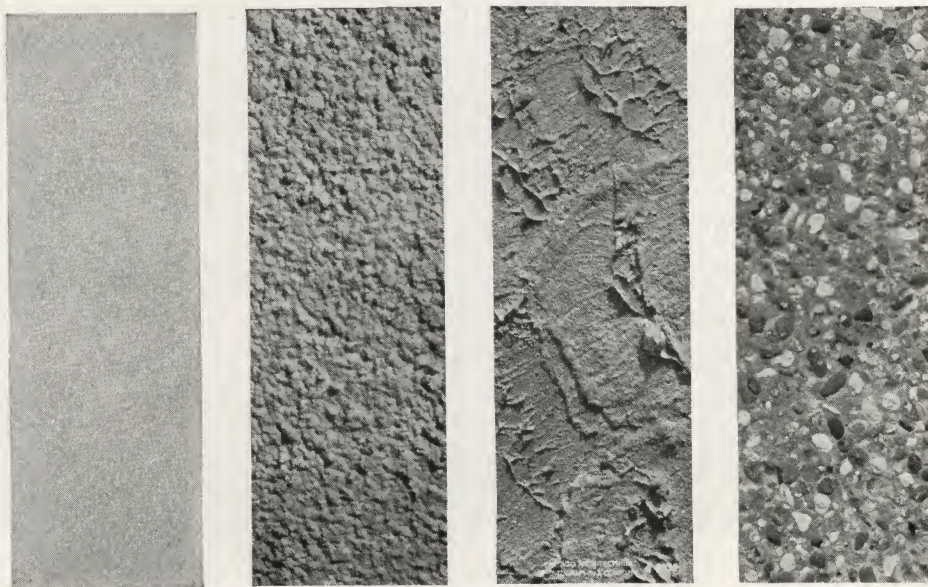


Fig. 46. Four attractive portland cement stucco finishes. Left to right: The sand float finish, the spatter dash finish, the sponge finish and the exposed pebble finish.

allowing mortar to dry along working edges. The first coat should be forcibly and thoroughly trowelled into the wall surface to obtain a firm bond. In two-coat work, when the "scratch" coat has been applied, it preferably should be followed by a second application of mortar as soon as it is stiff enough. This is called "doubling." The surface of the first coat should be roughened or scratched before it hardens to provide key for the second coat which is usually applied the next day after the first coat. The surface of second coat (if a second or intermediate coat is used) should also be roughened to provide key for the finish coat. Keep the first and intermediate coats wet for several days by carefully applying water at intervals (as soon as each coat has hardened enough so that it will not wash). The finish coat is usually not applied until the previous coat, or coats, have been on at least a week. The finish coat should average about $\frac{1}{4}$ -inch in thickness. When applied directly to block, the combined thickness of the first coat and the intermediate coat (if used) need not average over $\frac{3}{8}$ -inch.

Stucco Information on Request

A variety of beautiful stucco finishes are available—textures and color tones perfectly

adapted to every use. These are all explained and their method of application described in "Portland Cement Stucco" a booklet issued by the Portland Cement Association. A copy of this booklet may be obtained free on request. Portland cement stucco owes its popularity to its long record of successful use. Difficulties in mixing or application can be easily overcome by making use of the information contained in the foregoing booklet.

Mortar Colors

When color tints are desired for mortar block facings, or stucco surface coat, coloring matter in the form of finely ground minerals not in excess of 10 per cent of the weight of the portland cement may be used without fear of reduction in strength.

A carefully determined weight of color should be added to each batch of fine aggregate before the cement or water is added. The color and fine aggregate should be mixed together and then the cement added. The whole should then be thoroughly mixed dry until the entire batch is of uniform color. Water should then be added and mixing continued to bring the mass to uniform and proper consistency.

Table of Colors to Be Used in Portland Cement Stucco

COLOR DESIRED	COMMERCIAL NAMES OF COLORS FOR USE IN CEMENT	Pounds of Color Required for Each Bag of Cement to Secure	
		Light Shade	Medium Shade
Grays, blue-black and black.....	{ Germantown lampblack*.....	$\frac{1}{2}$	1
	{ Carbon black.....	$\frac{1}{2}$	1
	{ Black Oxide of manganese.....	1	2
Blue shade.....	Ultramarine blue.....	5	9
Brownish-red to dull brick red.....	Red oxide of iron.....	5	9
Bright red to vermillion.....	Mineral turkey red.....	5	9
Red sandstone to purplish-red.....	Indian Red.....	5	9
Brown to reddish-brown.....	Metallic brown (oxide).....	5	9
Buff, colonial tint and yellow.....	{ Yellow ochre**.....	5	9
	{ Yellow oxide.....		
Green shade.....	Chromium oxide.....	5	9

*Only first quality lampblack should be used. Carbon black is light and requires very thorough mixing. Black oxide or mineral black is probably most advantageous for general use. For black use 11 pounds of oxide for each bag of cement.

**Should contain not less than 15 per cent of the oxide.



Bethel M. E. Church, Pueblo, Colo.

WHETHER for social, industrial, educational or recreational purposes, buildings of concrete masonry construction afford permanence, firesafeness, low maintenance and beauty. These outweigh all arguments for building of less enduring materials.



Auburn Automobile Co. factory, Auburn, Ind.



Strand Theatre, Rock Rapids, Iowa



Naval Academy, Geneva Lake, Wis.



Grand Stand Davenport, Iowa

Suggested Specifications for the Application of Portland Cement Stucco on Concrete Block and Tile Walls

CONCRETE BLOCK AND TILE WALL CONSTRUCTION

Concrete block and tile should meet the requirements of the proposed standard specifications of the American Concrete Institute. (See pages 30 and 31.) Sample block from those delivered to the building may be tested by the architect if desired, and if the samples fail to meet the requirements, the entire shipment may be rejected. The tests to be made at a recognized testing laboratory in the methods prescribed by the American Concrete Institute.

Concrete block and tile should be laid in portland cement mortar mixed in the proportion of one sack of portland cement to three cubic feet of sand to which may be added hydrated lime not to exceed 25 per cent of the volume of the cement in the mixture. All joints to be cut flush with the wall surface. The surface of block and tile to be stuccoed should be rough and of coarse texture.

PORTLAND CEMENT STUCCO

The whole of the outside walls including porches, chimneys, piers, etc., shall be covered with portland cement stucco applied directly to the concrete block or tile, down to the level of first floor belt course, soldier course or other stopping point as shown. Below this point the walls to be rendered down to grade in portland cement plaster about 3/4-inch thick trowelled smooth.

Metal Lathing

The soffit of eaves, ceilings of porches and other parts so shown to be lathed with galvanized or painted metal lath weighing not less than 3.4 lbs. per square yard secured with 1/4-inch galvanized staples made of 14 gauge wire and driven tightly to penetrate at least 1/8-inch. Lath to be lapped at least one inch at junctions and laps to be at least 12 inches away from corners. Over all flashings place a strip of metal lath at least 8 inches wide, nailed into joints of wall to form key for stucco.

Preparation of Wall

Before applying the stucco, the wall surface should be brushed free from all dust, dirt and loose particles and thoroughly wetted, and should be in this condition when the mortar is applied.

Aggregate

Aggregate for undercoat shall be thoroughly clean sand, graded from fine to coarse grains, with the coarse predominating; shall be free from loam, salt, vegetable and other deleterious matter. Aggregate for finish coat shall be thoroughly clean coarse white quartz or silica sand, or white marble screenings, or gravel grit, or pink granite screenings, etc., as architect selects. Samples are to be submitted for his approval.

Color Pigments

When color is to be produced other than by the use of colored aggregate, mineral colors only shall be employed. Coloring matter shall be dry color pigments, of the highest degree of purity, of substantially the same specific gravity as the cement, proof against the action of lime, cement or the action of the elements and guaranteed by the plasterer to stand without fading for 5 years.

Water

Water shall be clean and free from acids or strong alkalis.

Mortar

Mortar for first coat shall be composed of one (1) part of portland cement, three (3) parts of sand. Hydrated lime if used must not in any case exceed twenty per cent by volume of the cement used.

Mortar for finishing coat shall be composed of one (1) part of portland cement and three (3) parts of white sand, or other aggregate required to obtain finish selected by owner. If finishing coat shall be colored it shall be brought to the tone selected by the addition of dry color in quantity not exceeding 10 per cent of the weight of the cement.

Proportions stated are by volume and one bag (94) pounds of cement is to be considered as one cubic foot.

Mixing

Mixing shall be done on a water-tight mortar box, the different constituents thoroughly mixed dry to a uniform color, water then added to obtain the proper consistency and the whole turned over until the mass is uniform in color and consistency. There shall not be mixed at one time more mortar than will be used within thirty (30) minutes. No retempered mortar shall be used under any circumstances. The dry color in the finishing coat shall be very carefully weighed or measured and thoroughly mixed with the sand. The cement and lime shall then be added and the entire mass thoroughly mixed by shoveling, from one side of the platform to the other, through a 3/4-inch mesh screen. When the batch is of uniform color the water shall be added.

Mortar Application

Stucco shall be applied in two coats, each coat not less than 3/4-inch thick, the whole 3/4-inch thick beyond the normal masonry line. The plastering shall be carried on continuously in one general direction, without allowing the mortar to dry at the edge. Where this is impossible, the joints shall be made at a break, an opening or other natural division of the surface. Stucco shall not be applied when the temperature is below freezing, or when, during falling temperatures, thermometer has reached 40 degrees. Surfaces shall

be cleaned and thoroughly saturated with water just before the first coat of mortar is applied. The first coat shall be well pressed on to secure a good bond. The undercoat shall be cross-scratched before the initial set has taken place and shall be thoroughly wetted before the last coat is applied.

The finish coat shall not be applied until at least one week after the first coat and shall be applied and finished as hereinafter specified.

The finishing coat shall be kept moist for at least two days, either by gently spraying with water after the mortar has hardened sufficiently to permit it or by hanging wet burlap or other fabric over the surface.

Surface Finish

There are many methods of finishing stucco surfaces, therefore contractor should submit samples to architect for selection. The following specifications apply to the various finishes:

SURFACE FINISHES

Stippled Finish

A stippled finish is obtained by lightly patting the finishing coat with a brush of broom-straw to give an even, stippled surface.

Rough Cast or Spatter Dash

A mixture of one sack of cement to 3 cubic feet of fine aggregate is thrown forcibly against the newly placed finishing surface to produce a rough, uniform texture when viewed from a distance of 20 feet. A variety of spatter dash finish can be secured by using colored aggregate.

Pebble Dash

Before the finishing coat has begun to harden, clean, round pebbles or other material as selected, not smaller than 1/4-inch or larger than 3/4-inch, previously wetted, are thrown forcibly against the wall so as to imbed themselves in the fresh mortar. They should be distributed uniformly over the surface of the final coat and pushed back into the mortar with a clean wood float. No rubbing should be done after the pebbles are imbedded.

Exposed Aggregate

The finishing coat is composed of an approved, selected coarse sand, crushed marble or granite or other special material, in the proportion given for finishing coats. Within 24 hours after being applied and trowelled to an even surface, it is scrubbed with a stiff brush and water. If the stucco is too hard, a solution of one part hydrochloric acid in four parts of water by volume can be used. After the scrubbing, all traces of the acid should be removed by thorough spraying with water from a hose.

Sand Floated

A sand floated finish is obtained by rubbing the finishing coat with a circular motion of a wood float, a little sand being added to slightly roughen the surface. This floating should be done when the mortar has partly hardened.

Sand Sprayed

A sand sprayed finish is obtained by spraying on with as much force as possible, by means of a long fibre brush or whisk broom, a creamy mixture of equal parts of cement and sand, mixed fresh at least every 30 minutes and kept well stirred until used. This treatment should be applied before the finishing coat has attained its early hardening, that is, within three to five hours. The addition of hydrated lime not to exceed 10 per cent of the weight of the cement in the mixture, will produce lighter shades of finish.

Smooth Finish

The finish coat should contain all the material desired in the finished surface. The trowelling of the finish coat should be continued until the desired smoothness and texture is obtained, but should be the least possible to produce this surface finish. Particular attention to proper curing methods is absolutely necessary to obtain the best results with this type of finish.

Sponge Finish

Immediately after the finishing coat has been brought to an even surface, a clean, soft pine float is pressed down onto the surface and withdrawn, care being taken not to separate the surface coat from the undercoat.

Samples

Samples of the surface finish shall be laid up well in advance of the work and the approved sample shall be carefully preserved during the execution of the work.

Window Frames

Stucco shall be well worked against the frames and the contractor shall see that staff beads on frames are removed before plastering is started.

Protection

All materials shall be properly protected while stored at the site and shall not be placed on the ground. Fresh stucco shall be protected against the weather. No stucco in which cracks, pits, streaks, discolorations, or other defects may occur will be accepted.

American Concrete Institute

PROPOSED STANDARD SPECIFICATIONS FOR CONCRETE BUILDING BLOCK AND CONCRETE BUILDING TILE.

*Submitted by Committee P-1, on Standard Building Units
Tentatively Adopted by the Institute, January, 1923*

1. The purpose of these specifications is to define the requirements for concrete building block and concrete building tile to be used in construction.

2. The word "concrete" shall be understood to mean portland cement concrete.

Strength Requirements

3. According to the strength in compression 28 days after being manufactured or when shipped, concrete block and concrete tile shall be classified as A—heavy load bearing, B—medium load bearing, C—light load bearing, and D—non-load bearing on the basis of the following requirements.

Name of Classification	Compressive strength, lb. per sq. in. of gross cross-sectional area as laid in the wall.	
	Average of 3 or more Units	Minimum for Individual Unit
A—Heavy load bearing block or tile.....	1,200	1,000
B—Medium " " " " ".....	700	600
C—Light " " " " ".....	500	400
D—Non- " " " " ".....	250	200

4. The gross cross-sectional area of a one-piece concrete block or tile shall be considered as the product of the length times the width of the unit as laid in the wall. No allowance shall be made for air spaces in hollow units. The gross cross-sectional area of each unit of a two-piece block or tile shall be considered the product of the length of the unit times one-half the thickness of the wall for which the two-piece block or tile is intended.

5. The compressive strength of the concrete in units of all classifications except class "D" shall be at least 1,000 lb. per sq. in., when calculated on the minimum cross-sectional area in bearing.

Absorption Requirements

6. Concrete building block and tile to be exposed to soil or weather in the finished work (without stucco, plaster or other suitable protective covering) shall meet the requirements of the absorption test.

7. All concrete building block and tile not covered by paragraph 6 need not meet an absorption requirement.

8. Concrete block and tile shall not absorb more than 10 per cent of the dry weight of the unit when tested as hereinafter specified, except when it is made of concrete weighing less than 140 pounds per cubic foot. For block or tile made with concrete weighing less than 140 pounds per cubic foot, the absorption in per cent by weight shall not be more than 10 multiplied by 140 and divided by the unit weight in pounds per cubic foot of the concrete under consideration.

Sampling

9. Specimens for tests shall be representative of the commercial product of the plant.

10. Not less than three and preferably five specimens shall be required for each test.

11. The specimens used in the absorption test may be used for the strength test provided they have been dried at approximately seventy (70) degrees Fahrenheit for not less than three days.

METHODS OF TESTING

Strength Test

12. The specimens to be tested shall be carefully measured for overall dimensions of length, width and height.

13. Bearing surfaces shall be made plane by capping with plaster of Paris or a mixture of portland cement and plaster which shall be allowed to thoroughly harden before the test;

14. Specimens shall be accurately centered in the testing machine;

15. The load shall be applied through a spherical bearing block placed on top of the specimen;

16. When testing other than rectangular block or tile care must be taken to see that the load is applied through the center of gravity of the specimen;

17. Metal plates of sufficient thickness to prevent appreciable bending shall be placed between the spherical bearing block and the specimen;

18. The specimen shall be loaded to failure;

19. The compressive strength in pounds per square inch of gross cross-sectional area is the total applied load in pounds divided by the gross cross-sectional area in square inches.

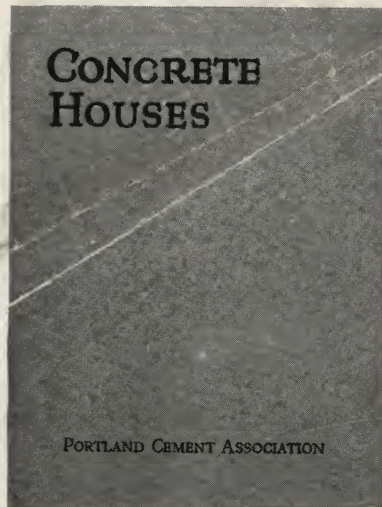
Absorption Test

20. The specimens shall be dried to constant weight at a temperature of from two hundred and twelve (212) to two hundred and fifty (250) degrees Fahrenheit and the weight recorded. After drying, the specimens shall be immersed in clean water at approximately seventy (70) degrees Fahrenheit for a period of twenty-four (24) hours. They shall then be removed, the surface water wiped off and the specimens re-washed. The absorption is the weight of the water absorbed, divided by the weight of the dry specimen and multiplied by one hundred (100).

Weight of Concrete

21. The weight per cubic foot of the concrete in a block or tile is the weight of the unit in pounds divided by its volume in cubic feet. To obtain the volume of the unit, fill a vessel with enough water to immerse the specimen. The greatest accuracy will be obtained with the smallest vessel in which the specimen can be immersed with its length vertical. Mark the level of the water, then immerse the saturated specimen and weigh the vessel. Draw the water down to its original level and weigh the vessel again. The difference between the two weights divided by 62.5 equals the volume of the specimen in cubic feet.

BOOKS for BUILDERS

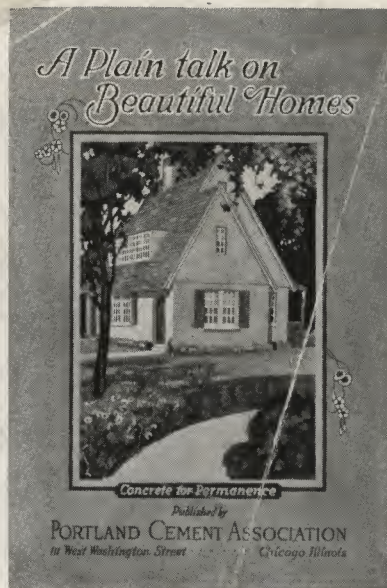


A Guide to Beauty, Permanence
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"Concrete Houses"

This book shows architects' sketches and floor plans for twenty-five (25) typical small homes and three garages. It describes our house plan service, shows a page of typical details of concrete house construction and contains a blank for ordering complete plans, specifications and quantity surveys of the houses shown.

It has become a popular book with products manufacturers, real estate operators and contractors who use it to interest their customers. Many prospective home owners have sent for it because of its good house plans and valuable information. Sent postpaid on receipt of 50 cents in money order.



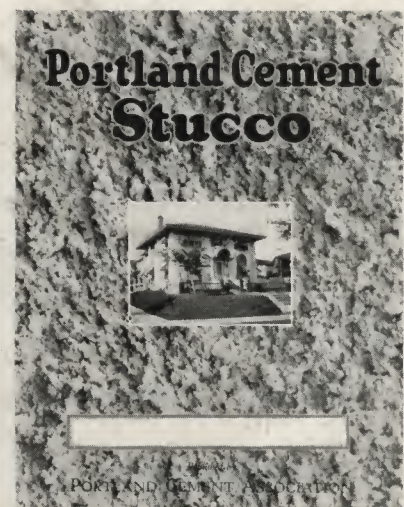
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A book for the man who wants to build a permanent home that is beautiful, comfortable and firesafe.

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How to design basement and foundation walls and footings; how to lay out a foundation; build forms; mix and place concrete so it will be watertight; build cellar steps; lay a concrete block foundation. Sent free on request.



Indispensible to those who do stucco
work—or pay for it

"Portland Cement Stucco"

Complete specifications and details of portland cement stucco construction, with close-up illustrations of surface finishes. Every detail of good stucco practice is described. Many excellent examples of the use of portland cement stucco in both warm and cold extremes of climate are pictured. A valuable table of colors to be used in cement stucco is included.

Of real value to the architect, builder and owner. Free on request.

THE booklets described above should be in the hands of every builder and prospective home owner. Educational booklets and pamphlets, fully illustrating and describing a great

variety of other uses of concrete, also await your request. With the exception of the book "Concrete Houses" these are all free and involve no obligation. Consult us freely.

Portland Cement Association

A National Organization to Improve and Extend the Uses of Concrete

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